NEXT MONTH

To many chemical engineers the synthetic organic chemical industry is an up-start among the process industries. And this is no wonder, for the American branch of this industry is scarcely 25 years old. Its vertical growth, which began in earnest only about 10 years ago, has been so rapid that its largest division showed a production increase of 570 percent within the past 10 years! How does this precedent-breaking, fastest-growing and most versatile member of the chemical family define itself? What are the opportunities for chemical engineers in an industry that in 1940 paid 3.3 percent of all sales for research? What are the duties, salaries, opportunities for advancement in the field and what qualifications are most needed for success? "Opportunities in the Synthetic Organic Chemical Industry," third of a series of such reports by the editors of *Chem. & Met.*, will be devoted to an evaluation of chemical engineering opportunities in "the chemical industry of the future."

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CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902

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VOLUME 48 SEPTEMBER, 1941 NUMBER 9

Saved! 50,000 Barrels of Beer!

THE MOTOR THAT WOULDN'T GIVE UP! B. E. Dutton, Chief Technical Engineer of the Adolph Coors Company, Golden, Colorado, shows how 25 inches of water soaked this Lo-Maintenance Motor. But water didn't stop it, and $500,000 worth of beer was saved

How Lo-Maintenance Motors Fought a Flood—Kept Refrigeration Going—and Saved the Beer Stock of the Adolph Coors Company in Golden, Colorado.

WHEN A MIDNIGHT cloudburst flash-flooded Clear Creek and Golden Gate Canyons, water flooded the sub-basement, housing auxiliary power plant equipment of the Adolph Coors Company in Golden, Colorado. Before it was discovered, 25 inches of water covered the basement — and threatened the refrigeration of $500,000 worth of beer in storage.

All pumps and motors were immediately shut down, except those necessary to maintain power plant operation. Though partially submerged, the circulating pump and motor of the Turbine condenser *never stopped . . . and it's still running!*

In addition, the Allis-Chalmers pump and motor at well No. 2, which supplies make-up water to the boiler, *ran completely under water for six long hours — and never gave up!*

Altogether — seven Lo-Maintenance Motors that were completely or partly submerged *are operating perfectly today in spite of their punishing experience* — though other motors had to be baked or rewound.

We don't claim that Lo-Maintenance Motors are built for under-water operation . . . but dependable service like this — far more than just a rated horsepower — is one of the outstanding achievements of Allis-Chalmers Motors.

Full-measure construction, distortionless stator, indestructible rotor, high carbon steel frame and other great extra value engineering features are your guarantees of trouble-free performance. Get the facts from the trained engineers in the district office near you. Or write Allis-Chalmers, Milwaukee.

ALLIS-CHALMERS LO-MAINTENANCE MOTORS

A COMPLETE LINE FOR EVERY PURPOSE...ONE-HALF HORSEPOWER AND

CHEMICAL
& METALLURGICAL
ENGINEERING

ESTABLISHED 1902

S. D. KIRKPATRICK, Editor

SEPTEMBER, 1941

PAY-OFF IN THE WEST

WE WERE in the comfortable new office of a small progressive chemical manufacturer on the West Coast. He told us how he had slowly built up his business until he was now supplying a good share of the local market for certain heavy chemicals that formerly came entirely from the East. Lately, however his costs had mounted because of increased freight on his raw materials and he had been forced to raise his prices—on one particular product, by 20 cents a hundred. He was just asking us what we thought his eastern competition might do about this when someone from his own sales force brought in a letter that not only answered his question, but seemed to us to point a significant moral.

As of that date his principal competitor for this product had announced an increase of 50 cents per hundred, applicable to all consumers on the West Coast except those in a limited territory, where the rise would be but 20 cents. The letter explained that this adjustment was necessary because ocean shipping was no longer available and the buyer would have to pay the higher cost of rail transportation. There was no explanation, however, for the 30-cent differential in favor of certain consumers whom, as you have no doubt guessed, resided in the territory served by our friend. This was that community's dividend for having encouraged local enterprise. This, multiplied by the tonnage of that particular market and added to similar savings in perhaps hundreds of comparable cases, is the great pay-off in the West today.

Time and energy and money invested in western enterprise are now becoming more and more productive. The great undeveloped resources of cheap power and abundant raw materials are suddenly coming into their own. The national defense program has not only upset the transportation situation on the West Coast, but the real magnitude of its demands has stimulated bold planning and action. Within a matter of months, the Pacific Northwest has become a thriving center of electrochemical and electrometallurgical industries whose power requirements could not be met at comparable rates anywhere else in this country. The aircraft and shipbuilding industries are making thousands of jobs and building millions in purchasing power. Everyone of the 11 Western States is contributing some strategic mineral or metal to the national defense. Western industry is alive to its opportunities. It is building, both for today and for that indeterminate future of the post-war period.

Chemical engineers and the executives of chemical enterprises elsewhere in the United States need not—in fact should not—sit back and idly watch what's happening in the West. There are lessons to be learned as well as jobs and opportunities. The eastern manufacturer who forces his western customers to pay out too much of their purchasing power for high cost transportation is merely holding an umbrella over some small, but enterprising competitor out there. If he continues long enough, the little fellow will have grown strong enough to hold his own umbrella, and with it a goodly part of the western market. The obvious moral here is that chemical production must be further decentralized through branch plants or manufacturing subsidiaries. Otherwise the larger companies are going to lose more and more of their western business.

Meanwhile there is no stopping of the little fellow. He's as much a part of the West as the prospector of the early days. He is the man who

has been fighting for the business in sparsely populated markets where distribution has always been difficult and costly. Now he is coming into his own. He is entitled to his share of the pay-off that is the West's today.

MAKING UNCLE SAM A BETTER BUYER

Government purchasing can be materially improved in many ways. Particularly is there a large opportunity for simplification and standardization of government purchases, as well as for use of commercial types of goods and equipment instead of the "specialties" which the government is so often likely to specify.

A very sincere effort is being made by government executives to improve buying technique. The leadership of Donald M. Nelson, as coordinator of purchases, has been an outstanding public service. The Army and Navy particularly are benefitting, with incidental great advantage to taxpayers.

This movement deserves more support from industry. Particularly it is worth while for sales managers of process industries to bring to the attention of government purchasing agents any new specifications or improved methods of purchasing or packaging.

If the individual procurement office does not take kindly to worth-while suggestions, then they should be sent to the new coordinator of purchases, for his review. This is no time to retain complications, simply through the whim of some individual or official agency. The higher government executives will appreciate help and will see to it that worthwhile suggestions are promptly adopted.

OUR MINISTRY OF SUPPLY

Appointment of the new Supply Priorities and Allocations Board establishes in Washington an American counterpart of the Ministry of Supply which Britain has found so effective. This is good news to the chemical process industries and for chemical engineers. It is still better news to know that Donald M. Nelson is to be the executive director of this new body. All of us who have known him personally as an able member of the chemical profession, as well as an outstanding business man, will expect great things from his leadership.

This development brings under single administrative direction the varied phases of chemical activity. No longer will process industry representatives be shunted hither and thither in the mazes of Washington when they attempt to find out what to do about making, marketing, pricing or otherwise administering chemical problems. No longer will those who need chemicals have to wonder where to start in their search for official aid. There will be sooner or later one well-organized coordinated chemical unit. And that is a tremendous step forward in organizing for defense.

This new organization comes at a most timely moment. Perhaps never in the history of chemical industry has there been so much discouragement over the difficulties in prospect. Certainly never has there been, even in World War days, such an impending shortage of chemicals. The new agency cannot all at once create remedies for all our ills. Nor will it be able to solve all the shortages. But it can do much to cushion the impact of the blows as they fall. And a well-organized technically-led Ministry of Supply will have more enthusiastic support from industry because there will be more confidence in the men who are doing the job.

One of President Roosevelt's great difficulties has been in the selection of subordinates whom he was willing to clothe with real authority. It looks in this case as though the naming of a board of seven headed by Vice-President Wallace would give the President confidence enough to grant full authority in the functioning of the new S.P.A. Board. Mr. Nelson through industrial work has demonstrated his great capability. Through official work he has demonstrated that he has equal talent for government administration. Apparently he has the full confidence of the President. Certainly he will have the support of industry.

WANT TO TEACH?

Many engineering colleges are in urgent need of more faculty people in chemical engineering. Perhaps there are some chemical engineers who would like to teach, and who would be qualified to serve in this emergency. *Chem. & Met.* gets many of these queries. If we can serve as a go-between to bring men and institutions together, we will be glad to help.

Good teachers are scarce. Any competent chemical engineers, especially those experienced in teaching, should get onto the job promptly.

GOOD-BYE AND GOOD LUCK!

This issue is, in a sense, a swan song for an old friend whom for 15 years we have been proud to call our Pacific Coast Editor. Dr. Paul D. V. Manning takes with him to Chicago in his new job as director of research for International Agricultural Corporation not only our good wishes, but those of thousands of friends and acquaintances throughout the chemical engineering profession. We rejoice in his opportunity to return to fields that have long held his interest and to which he has already made important contributions. His new work, we hope, will bring him into more frequent and intimate touch with the national groups of engineers, chemists and electrochemists, whose meetings in recent years have been largely deprived of his personal attendance and participation. We hate to haul down his name from the *Chem. & Met.* masthead but are deeply grateful for long years of unselfish help and counsel. Good luck, Paul Manning, and don't forget your *Chem. & Met.* training!

CHEM & MET REPORT ON

Progress and Trends in Western Process Industries

TO EXECUTIVES AND ENGINEERS OF CHEMICAL ENTERPRISES

National defense has pushed ahead by at least five years the industrialization of the West. Many electrochemical and electrometallurgical developments forecast by Chem. & Met. in its 1931, 1935 and 1938 reports on the 11 Western States are already far advanced. Others, including several basic branches of chemical industry, are now urgently needed to complete a sound foundation on which a well-rounded, peace-time economy can be built. Cheap power and undeveloped mineral resources have so far proved the primary attraction for bringing a number of large industries to this territory. Of increasing importance, however, are the growing markets for chemicals and allied materials and the urge for self-sufficiency that is stimulating the training of necessary manpower and the development of essential equipment and manufacturing facilities.

CHEMICAL AND METALLURGICAL ENGINEERING

SEPTEMBER, 1941

Progress and Trends in Western Process Industries

SUMMARY AND CONCLUSIONS

The purpose of this report is to bring *Chem. & Met.* readers up-to-date on kaleidoscopic changes that have occurred in the chemical process industries of the 11 Western States since our last comprehensive survey in September 1938. It is based on first-hand studies of recent developments, trends and influences observed in more than 10,000 man-miles of travel and hundreds of interviews and plant inspections. This has been supplemented by field reports from correspondents and current data made available from unpublished, as well as printed, sources.

Most significant conclusions may be briefly summarized as follows:

Availability of cheap power, combined with abundant natural resources, especially of strategic raw materials, has already led to the rapid development of certain important national defense industries, particularly, aluminum, magnesium, ferro-alloys and electrochemical products.

Drastic curtailment of ocean and coast-wise shipping has put a heavier burden on the railroads and added materially to the delivered cost on the West Coast of many chemical products and commodities in which chemicals are used. Thus, there is a new and greater stimulus to the urge for self-sufficiency.

Many small new industries are developing to fill local needs which are rapidly increasing as defense industries have stimulated consumer and industrial purchasing power.

Technical man-power and the necessary mill supplies and chemical engineering equipment are generally available from western sources. There is, however, a need for coordination of efforts and greater recognition of the opportunities for both men and machinery.

Chemical engineers and executives of all chemical enterprises throughout the United States can help themselves and their industry and profession by a better understanding and more intensive study of trends and developments than can only be outlined in this brief report.

Western Trends and Influences

A FEW YEARS AGO the government's huge program for the development of hydroelectric power on the West Coast seemed almost fantastic, Everyone knew that in this area were great unexploited resources not only for power but also for minerals and other raw materials. But any large-scale industrial development seemed to be in the dim and distant future. About the best that could be hoped for was a slow and gradual growth as small new enterprises pioneered their rocky way in the face of such discouraging obstacles as sparsity of population and markets, high transportation costs for raw materials and equipment, and a lack of skilled and technically trained personnel.

Then, the situation changed almost overnight. As the national defense program unfolded, it became obvious that its demands for the light metals, aluminum and magnesium, were far in excess of the country's productive capacity. Furthermore, since power may represent as much as a fifth or a sixth of the total production cost of these metals and since these requirements could not be met at comparable cost anywhere else in the United States, it was only natural that attention should be directed toward the West Coast where so many millions had been and were being spent for hydroelectric developments. The wholesale rate from Bonneville of 2 mills or less per kwh. put this power into the very lowest brackets —a full third below those of TVA, for example.

This power was the spark that set off the great electrometallurgical development of the Northwest.

Realization of the logical relation of these light metals to the aircraft industry of the West Coast came after rather than before this development. In other words, it was not until cheap power had attracted an aluminum industry to the Northwest that we began to think about fabricating plants to turn out the sheets and shapes in which the metal and its alloys were to be used in building airplanes. Likewise, just as these utilization and application plants soon justified their location in the West, so will other industries to

supply needed raw materials and equipment. Carbon electrodes from petroleum and coke are already a part of Alcoa operations at Vancouver, Wash. Purification of imported or domestic bauxite to produce the necessary refined alumina would seem the next logical step.

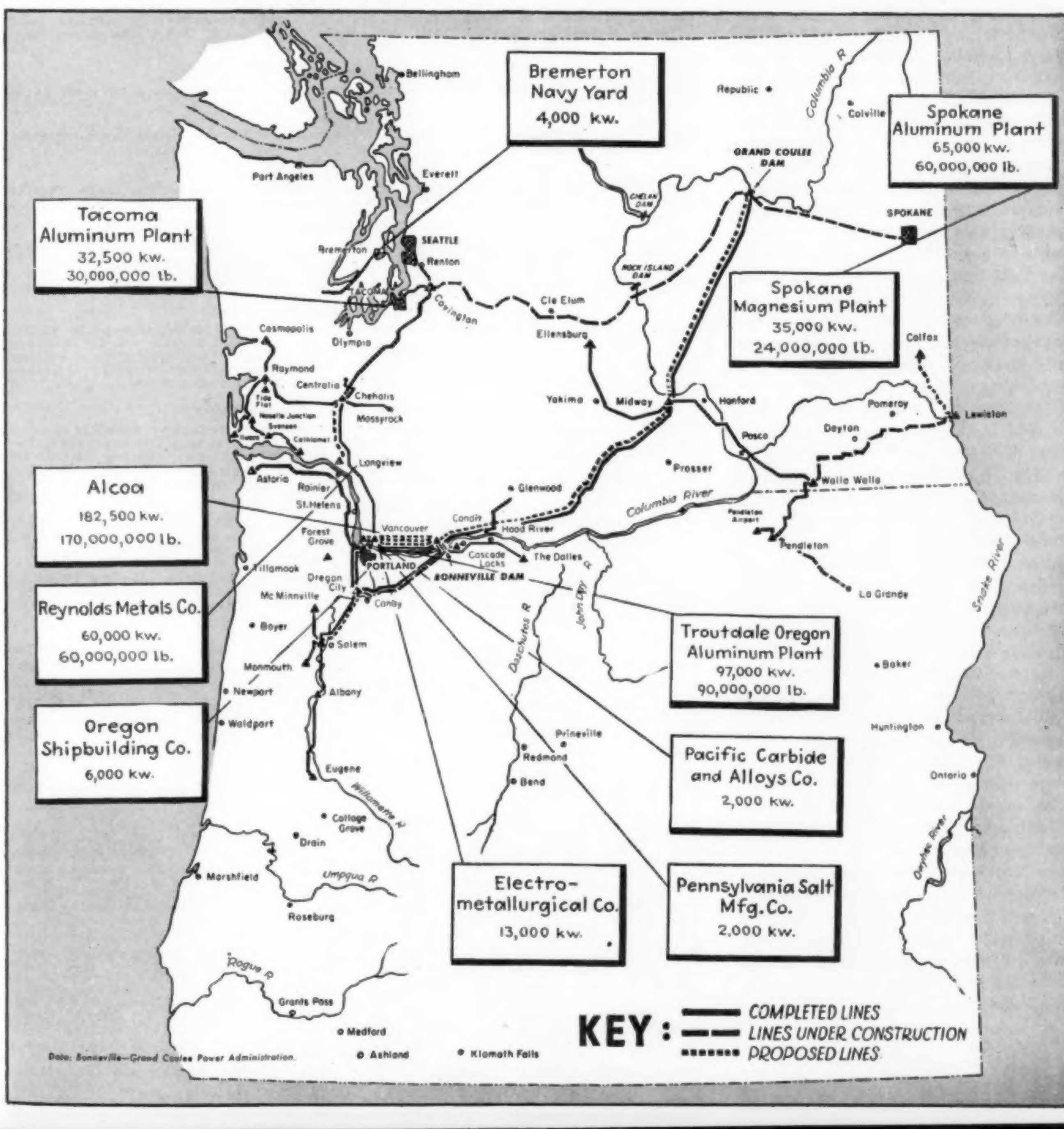
National defense has also greatly stimulated other industries in the 11 Western States. Potash in New Mexico, tungsten in Colorado, mercury in California, are a few of many raw materials that suddenly sprang into importance. But older products like petroleum products, paint and varnish, rubber goods, soap and sugar also felt the effect of increased activities and purchasing power.

There are no chemical munition plants (smokeless powder, TNT, etc.) in the 11 Western States at this time, but it is evident that such developments are definitely in prospect. Several existing plants produce explosives for mining, construction and agricultural uses. Sodium chlorate, shortly to be made in Portland for use as weed killer, could readily be adapted to the manufacture of chlorate types of explosives. Elemental phosphorus for incendiary bombs could readily be made in electric furnaces utilizing the extensive western deposits of phosphate rock. Twenty such industries that are possible of development in the Pacific Northwest are given in Table I compiled by the staff of the Bonneville Power Administration. The accompanying map (Fig. 1) shows existing or immediately projected plants in this same area.

The 11 Western States comprise 40 percent of the land area of the United States—yet, with the exception of aircraft and shipbuilding, they lack definite defense industries to protect the Pacific Coast and our Pacific possessions.

What we have seen developing in the electrometallurgical industries of the Northwest may, in the event of an "all out" defense effort, prove to be merely the forerunners of many other developments related to a wartime economy. Furthermore, many of these plants, e.g., for ferro-alloys, carbide and heavy chemicals, once

Fig. 1. New defense industries and plants under construction or immediately projected for the Pacific Northwest



established, are destined to continue as the nucleus for a well integrated peace-time economy. National defense has merely given the impetus to an even greater industrial development in the post-war epoch.

TOWARD SELF-SUFFICIENCY

The urge for self-sufficiency—to be independent of eastern sources of supply—is no new phenomenon in the 11 Western States. Difficulties, delays and high costs of transportation have always been a challenge to the ingenuity and resourcefulness of an active people, surrounded by vast undeveloped materials and resources. Lately, however, new incentive has been given this older urge.

As water transportation by coastwise shipping has been drastically curtailed because of the lack of cargo vessels, the consumers of products made in the East have been forced to pay the higher costs of rail transportation. Often this increment has been sufficient to encourage the establishment of small local enterprises or of branch plants controlled by companies that formerly shipped their products into the western territory. Once these businesses develop, the chances are that many of them will continue even after the return of normal shipping conditions. At least that has been the history of many, if not most, successful manufacturing enterprises that got their modest start in the Far West during the similar situation caused by the first World War.

Another factor that cannot be overlooked is the great western markets for both producer and consumer goods which have been developed in recent years. The demands of the petroleum industry, for example, soon outstripped the capacities of eastern suppliers of equipment and refining facilities. Small local industries sprang up and in a few years had grown to dominating positions in their fields. The specialized requirements of western agriculture had to be met by suppliers on the job who knew what was needed and how to apply it as well as to make it and sell it. The same story applies to the development of industries serving the pulp and paper mills of the Northwest, the lumber industries and the mines and metallurgical plants of the Mountain States. Self-sufficiency has long been a controlling influence. It will continue to be. Chemical manufacturers who are now serving western markets from eastern plants may well give thought to decentralization of their production. They may be holding an umbrella over some small competitor who some day will be strong enough to hold his own!

EFFECTS OF TRANSPORTATION

Reference has already been made to the current situation in which the extra costs of rail over water transportation is leading to the development of new industries in the Far West. Many comparable situations, however, are of long standing. We ship from western mines much of our copper, lead, zinc, mercury, tungsten and molybdenum to processing and fabricating plants 2,000 miles away, only to return a fair proportion another 3,000 miles for use on the West Coast—or even 6,000 or more miles to Hawaii or the Philippines.

The new aluminum industry in the Northwest suffers at the moment from an illogical transportation

TABLE 1. PRINCIPAL NATIONAL DEFENSE INDUSTRIES REC-

Products, primary uses in National Defense, and sources of raw materials available in or to Pacific Northwest

(1) IRON AND ALLOY STEELS

Uses: Ordnance mfgr., shipbuilding, engine mfgr., aircraft mfgr., tool steels, etc. *Sources:* Iron ore—Wash., Ore., Calif., B. C.; Wood for charcoal—Wash., Ore.; Coke—Ore; Coal—West Washington; Limestone—Wash., Ore.

(2) IRON & STEEL MELTING & ROLLING[1]

Uses: Ordnance mfgr., shipbuilding, engine mfgr., aircraft mfgr. *Sources:* Pig iron & scrap

(3) FERRO-ALLOYS (STAINLESS STEEL)

Uses: Alloy steels for: Shipbuilding, machine tools, ordnance mfgr., engine mfgr. *Sources:* Manganese—Mont., Wash., Ore., Idaho, Utah, Calif., Nev.; Chromium—Calif., Ore., Wash., Mont., Wyo., Alaska; Silica—Wash., Ore., Idaho, Wyo.

(4) ELECTROLYTIC MANGANESE & CHROMIUM

Uses: Emergency substitute for standard ferro-alloys. *Sources:* Mn & Cr same as for ferro-alloys above

(5) BRASS

Uses: Fuses, cartridge cases, fittings for ordnance & ships, instrument cases. *Sources:* Copper & zinc from Wash., Idaho, Mont.

(6) ELECTROLYTIC ZINC

Uses: Manufacture of brass Electrogalvanizing of ships' plates and Storage tanks. *Sources:* Zinc ores & concentrates from N. Utah, Wash., Ore., S. Idaho, possibly Nev. & N. Idaho

(7) MAGNESIUM

Uses: In aluminum and magnesium-rich alloys for military aircraft and aircraft engine construction. *Sources:* *Magnesite*—Wash & B. C.[2]; Magnesitic dolo'mite—Wash. Ore. Mont. B. C.; Olivine—Wash., Ore.[3]; Serpentine—Ore., Calif.; Talc—Wash., Idaho., Ore., Calif.; Saline lakes—Wash., Great Salt Lake (Utah); Pacific Ocean & Puget Sound

(8) NITROGEN & NITRO COMPOUNDS[4,12]

Uses: Explosives—Nitrocellulose (smokeless powder), picric acid, ammonium nitrate, TNT. *Sources:* Cellulose (wood pulp)—Wash., Ore.; Alcohol & ether—to be developed, Wash., Ore., Idaho, Mont., Utah; Sulphuric acid—mfre. to be developed from sulphur, pyrites; Nitric acid—ammonia, Chile nitrate, synthetic sodium nitrates; Benzene—Wash., Ore., Calif., Colo.; Ammonia—Calif. & local development; Toluene—Wash., Ore., Colo., Calif.

(9) EXPLOSIVES OTHER TRAN NITRO[4]

Uses: Igniter & Primer. *Sources:* Potassium chlorate—Potash, N. Mex.: Sodium chlorate, Ore.: Salt, Calif.; Antimony sulphide—Idaho, Wash., Ore., Mont.; Mercury fulminate—cf. below Lead sulphocyanate—Lead, Wash., Ore., Mont., Idaho. *Sources:* Detonators. *Sources:* Mercury fulminate—Hg from Wn., Ore.; nitric acid plus alcohol potential in Ore., Wash.; Lead azide—Lead, Idaho, Wash., Ore., Mont.; calcium carbide, Ore.

(10) CALCIUM CARBIDE[5, 6]

Uses: Oxy-acetylene welding, plastics, safety glass, rayon, explosives, solvents. *Sources:* Limestone—Wash., Ore., Idaho, Mont.; Charcoal & coke—Wash., Ore., Calif., Utah

(11) CHLORINE & CAUSTIC[7]

Uses: War gases, purify wood pulp & cotton linters for explosives, ethylene glycol for cooling aircraft engines, extraction Br from sea, sanitation of camps and water supplies. Caustic used to purify wood pulp & linters. *Sources:* Salt—Calif., Utah, Idaho, Wyo., N. Mex., Texas, La.

(12) CHLORATES[4]

Uses: Explosives, fuses, incendiary mixtures, smokes, caps, disinfectants. *Sources:* Salt—Calif., Ore., Wash.; Potash—N. Mex., Calif.

(13) SYNTHETIC AMMONIA[4]

Uses: Preparation of nitric acid, ammonium nitrate, explosives, fertilizer. *Sources:* Calcium carbide—Ore.; Electrolytic hydrogen—Wash.; Synthetic ammonia from atmospheric N and water-gas hydrogen—Ore., Wash., Calif.

(14) NITRIC ACID[4, 8]

Uses: Used in preparing explosives. *Sources:* Calcium carbide—Ore.; Synthetic sodium nitrate—Hopewell, Va.; Synthetic ammonia made at site; Salt petre—Chile. Sulphuric acid

(15) SULPHURIC ACID[4, 9]

Uses: Used in preparing explosives. *Sources:* Sulphur—Wash., Ore., Idaho, B. C., Alaska, Utah, Wyo.; Sulphur & sulphur dioxide—from pyrites and other sulphide ores—Wash., Idaho, Mont., Ore., N. Calif., B. C.; Import sulphur

(16) ALUMINUM[10]

Uses: Aircraft manufacture. *Sources:* High alumina clays, kaolins, alunite—Wash., Ore., Idaho

(17) CELLULOSE PLASTICS

Uses: Transparent cockpit covers, safety glass, wing dope, plane & instrument parts. *Sources:* Wood pulp—Wash., B. C., (Ore.); Cotton linters—Calif., Ariz., N. Mex.; other chemicals

(18) RAYON[11]

Uses: Parachutes, auto tire cord. *Sources:* Wood pulp—Wash., B. C., (Ore.); Cotton linters—Calif., Ariz., N. Mex.; other chemicals

(19) PHOSPHATES[4]

Uses: Fertilizer, smokes, incendiary bombs. *Sources:* Phosphate rock—Idaho, Mont., Utah, Wyo.; Sulphuric acid—Mont., B. C.

situation. At present bauxite ore from Arkansas or British Guiana is refined to alumina in Mobile, Ala. or East St. Louis, Ill., shipped across the country and electrolyzed in Washington (with cryolite imported from Greenland). Then the ingots are shipped back to fabricating plants in Cleveland and Detroit, only to be returned as alloy castings, forgings and structural shapes for use in west coast airplane plants. One step to correct part of this situation has already been taken in the establishment of aluminum and magnesium fabricating plants in the Los Angeles area.

Doubtless there are many comparable cases where transportation costs have added a heavy and perhaps unnecessary burden on the backs of industrial as well as domestic consumers in the 11 Western States. The answer, again, is the trend toward branch plants and decentralization of manufacturing.

Looking to the post-war economy, it is of course possible that advances in transportation may be such as to offset the advantages or disadvantages of present plant locations. Isn't it at least conceivable that the airplane will become a much more economical vehicle of freight transportation, thus unifying distant parts of our nation? What the automobile and the motor truck did after the World War was just as revolutionary. Whatever today's great boom in aviation may portend for the rest of us, it seems certain that the Western States will continue to benefit from it.

RELATIONS TO THE PACIFIC

Empty harbors and idle docks and warehouses tell only too well the story of what has been happening lately to the west coast shipping industry.* The practical cessation of imports from the Orient and greatly reduced coastwise shipments have seriously affected important sources of business and trade. Yet most Westerners regard this as a temporary situation. They foresee even greater activities in the future. They feel, more than most other sections of the country perhaps, that the problems of the Pacific are our own problems—that our island possessions and dependencies are ours to encourage, develop, and if necessary, protect. They also look forward to the time when ships will not be needed to haul war materials to Britain or Russia but can be available for building up greater world trade—looking particularly toward South America. Chemical industries that depend on imported raw materials, e.g., vegetable and fish oils, are going to continue to prosper on the West Coast. So will certain other industries that are set to supply foreign markets for dyes, pharmaceuticals, and similar products.

So much, then, for the general trends that have influenced or are resulting from the industrialization of the West. Now consider some of the natural and man-made resources that afford basic foundations on which further chemical development must rest—power, mineral and agricultural resources, man-power and employment, educational facilities, equipment and machinery of production. These are determining factors.

* Activities of militant labor, led by Harry Bridges, disastrously affected Pacific Coast shipping long before the present emergency.

OMMENDED BY BONNEVILLE POWER ADMINISTRATION

Plants feasible and under consideration for location in the Pacific Northwest

Required to Construct Plant, Months, Est.	Annual Plant Capacity, Tons	Power Requirements, Kw.	Labor Requirements, Men: Construction	Labor Requirements, Men: Operation	Plant Cost, Estimated
(1) IRON AND ALLOY STEELS					
9	300,000	98,000	1,000	1,800	$18,000,000 to $30,000,000
(2) IRON & STEEL MELTING & ROLLING					
6–12	....	10,000	....	....	....
(3) FERRO-ALLOYS (STAINLESS STEEL)[13]					
4–6	8,000–15,000	43,000	150	75	$1,500,000
(4) ELECTROLYTIC MANGANESE & CHROMIUM					
Mn 6–12	3,500–17,500	4,000–22,000	75–300	50–200	$350,000 to $3,000,000
Cr 9	8,750	40,000	200	150	$2,000,000
Cr 3	pilot plant	....	30	25	$50,000
(5) BRASS[14]					
....	25,000	1,000	....	....	....
(6) ELECTROLYTIC ZINC					
9–12	36,000	16,000	300	250	$4,000,000–$5,000,000
(7) MAGNESIUM					
12	20,000	50,000	500	250	$25,000,000 [15]
(8) NITROGEN & NITRO COMPOUNDS					
9	52,500 (smokeless powder)	....	....	....	....
....	52,500(TNT)	....	....	....	....
(9) EXPLOSIVES OTHER THAN NITRO					
9	....	....	....	....	....
(10) CALCIUM CARBIDE					
6	12,000 (limestone)	4,000	50	50	$125,000
12	30,000 (charcoal and coke)	10,000	100	100	$250,000
(11) CHLORINE & CAUSTIC					
6	7,000 (min.)	2,500	200	50	$500,000
(12) CHLORATES[16]					
6	2,500	2,000	150	50	$750,000
(13) SYNTHETIC AMMONIA					
9–12	36,000	75,000	....	....	$3,000,000–$6,000,000
(14) NITRIC ACID[17]					
9	140,000	7,500	....	175	....
(15) SULPHURIC ACID[17]					
9	150,000	500	....	75	....
(16) ALUMINUM					
....	200,000	400,000	....	....	....
(17) CELLULOSE PLASTICS[18]					
12	5,000	15,000 (acetate)	....	750	$5,000,000–$10,000,000
....	....	6,000 (viscose)		1,500	....
(18) RAYON[18]					
12	10,000	30,000 (acetate)	....	2,000	$20,000,000
....	....	12,000 (viscose)		4,000	....
(19) PHOSPHATES					
12	100,000	60,000	....	....	....

1. Alaska Junk Co., Portland, Ore., has large reserves of scrap, is negotiating for contract. 2. New extensive B. C. deposit of magnesite. 3, 40 sq. mi. olivine in Skagit & Whatcom counties Wash.; 50 million tons Cypress Island. (See Footnote 8.) 4. Listed because of linkage with explosives industry—including manufacture of chlorate, synthetic ammonia, nitric & sulphuric acids, phosphates & alcohol. 5. Pacific Carbide & Alloys producing in Portland. 6. Includes derivatives: acetylene, ammonium nitrate, urea, nitrocellulose, acetone, acetic acid, acetic anhydride, nitric acid, ethyl acetate, cellulose acetate, calcium cyanamide, ammonia, lead azide. 7. Pennsylvania Salt Mfg. Co., Tacoma; Hooker Electrochemical Co., Tacoma; additional markets for caustic & hydrogen must be sought. 8. Byproduct nitric acid may result from magnesium reduction plant. 9. Byproduct sulphuric acid may result from alumina plant. 10. Raw materials such as alunite and high aluminum content clays may be utilized by acid process for part of total amount indicated. Byproduct potash and sulphuric acid may then be available. 11. Estimated present potential western market: textiles, 17,000 tons/yr.; tire cord 15,000; total 32,000 tons/yr. 12. For comparable data on industrial alcohol, needed for smokeless powder production, see article by McIndoe, p. 111 of this issue. 13. Includes capacity under construction of Ohio Ferro Alloys Co., Electrometallurgical Corp. 14. Based on 10% of U. S. Production for 1940. 15. Awaiting results of pilot plant work. 16. Pennsylvania Salt Mfg. Co. building plant in Portland. 17. Plant capacity to cover needs of explosives plant. 18. Power figures include manufacture of major chemicals.

Power the Magnet

CHEAP POWER is most certainly the great electromagnet that has drawn many of our industries to the West. "Bonneville, Boulder and Grand Coulee have become national synonyms for cheap power in a region where rates have long been so low as to have attracted favorable comment even from President Roosevelt." (*Chem. & Met.* Sept. 1938, p. 472.) No other section of the country can offer available power at lower prices than those prevailing in this region. And since the Far West is served mostly by hydro-electric power, generally somewhat remote from heavy load centers, the territory has been honeycombed with a network of high tension lines (see Fig. 2.) that make large blocks of power available at almost any point where natural resources or other conditions dictate desirable plant locations. Thus cheap power at tidewater is a reality all along the Pacific Coast and at places like Bonneville on the Columbia River, it is possible to combine this advantage with immediate proximity to the generating source. In those sections of the West where hydroelectric power must be supplemented by energy from steam plants, cheap fuel in the form of petroleum and natural gas is usually available in abundance.

The fuel and hydro generated capacities of the larger public utility systems (those having an output exceeding 100,000,000 kwh. during 1940), are shown in Table II for the 11 Rocky Mountain and Pacific Coast States. Their relationship to the country as a whole is evident in Table III—both having appeared as supplements to the May 3, 1941 issue of *Electrical World*. It will be noted that these 28 systems with 313 plants have 18.1 percent of the generating capacity and 27.1 percent of the total output of comparable plants throughout the entire United States. Their 239 hydro plants, however, had 53.1 percent of the comparable capacity of the entire country. Their 74 fuel plants, on the other hand, were only 7.1 percent of the U.S. totals.

What is the current power situation in the various sections of the West? Following is a recent summary prepared largely by George C. Tenney, editor of McGraw-Hill's *Electrical West:*

Fig. 2. Electric transmission system in the Pacific Northwest, including 1942 fiscal year program of the Bonneville-Grand Coulee Power Administration

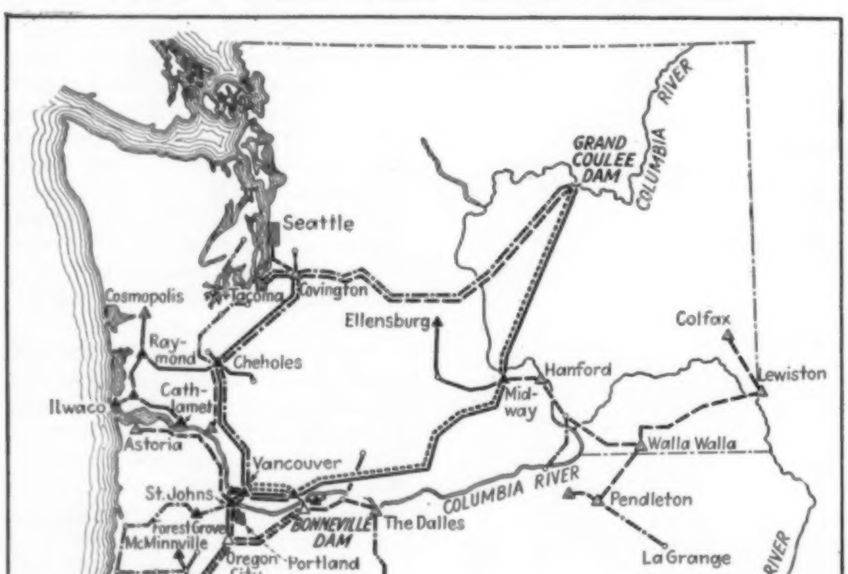


Fig. 3. Where new western power plants will be built—as FPC plans it

SOUTHERN CALIFORNIA

Major source of power for Southern California during recent years has been Boulder Dam where three giant 82,500 kw. generators are being added to the eight already in service. Two will be ready this year, the third early in 1942. Three transmission lines incorporating four circuits —three belonging to the Bureau of Power and Light of the City of Los Angeles and one to the Southern California Edison Co.—deliver this power to the Coast markets. Edison is building a second line to Boulder at the present time with completion schedule for late this year.

Standby and peak capacity for this area will be provided from a number of steam plant installations. The Glendale Municipal System will begin operation of a new 2,000 kw. turbo-generator this year. Burbank is adding two 10,000 kw. units to a new plant. The Bureau of Power and Light is planning the installation of a 65,000 kw. steam plant in the Harbor District. Some time early in 1942 the Bureau of Reclamation will complete the 90,000 kw. hydro plant being built at Parker Dam. The major part of this power will go to Arizona.

The aggregate of just the 1941 increments of these installations plus available capacity, according to Federal Power Commission data, shows 1,550,000 kw. of assured capacity, plus 310,000 kw. of reserves to meet an anticipated 1941 peak of 1,400,000 kw. In light of these facts, there can be no question as to the ability of the utilities in this region to meet any national defense power demands imposed on them.

NORTHERN CALIFORNIA

Turning to Central and Northern California, the Pacific Gas and Electric Co. is engaged in a construction program that will add upwards of 23 percent of additional generating capacity to its system by 1944 and will increase its load-carrying ability by approximately one-third. The system carried a peak load in December of 1,125,700 kw., which was an increase of 65,000 kw. from the preceding December. In its estimate of probable load increases in this region due to defense industry, the Federal Power Commission apparently used a figure of 140,000 kw. as a potential annual increase. The normal increase during recent years has been something under 50,000 kw. The California Railroad Commission's estimate of possible load growth during the coming year is the normal increase plus a maximum of 40,000 kw. of defense industry. In all probability the actual increase will be something between the 65,000 kw. which the load grew in 1940 and 85,000 kw. During the last five years the average annual increase in kilowatt-hour generation and receipts has been 5.7 percent.

What is P. G. and E. doing to meet these load requirements? A $20,000,000 steam plant construction program is nearing completion. One 44,000-kw. plant at Avon began operating in December and similar plants at Oleum and Martinez have been completed within the past three months. These plants are hooked up to the petroleum refining operations of the Tidewater, Union and Shell companies, respectively. They utilize excess refinery gases for which the refinery is compensated with one-half the current produced, plus four billion pounds of process steam per year. The Oleum plant is being equipped with an additional 40,000-kw. turbo-generator and three additional 200,000 lb. per hr. boilers which, when completed about two years from now, will double its present capacity.

A 21,000-kw. hydro plant is being built at Dutch Flat. Provision of some water storage facilities on the Pit River will increase the peaking ability of plants on that stream by 38,000 kw. Contracts have been let for the generating equipment for the Pit No. 5 hydro plant on Pit River, which will be completed in 1943. Work is being rushed on a substation at Piedra in the San Joaquin Valley which will double the present 75,000-kw. interconnection with the Southern California Edison Company. This tie-in, which calls for delivery of 150,000 kw. for a three-year period, will be completed to full capacity in January, 1942. There is also 10,000 kw. from a hydro plant to be built at Upper Narrows Dam on the Yuba River.

As already noted, the second 44,000-kw. steam unit at Oleum will be ready in July, 1943 and a 75,000-kw. unit at Midway in December of that year. This will give the P. G. and E. system a dry-year output capability of 1,775,000 kw. as of January 1,

Table II. Generator rating and output of large public utility systems in 11 Western States.

(From *Electrical World*, May 3, 1941)

Section and System	Generator Rating, Dec. 31, 1940: Fuel Burning: No. of Plants	Fuel Burning: Nameplate Rating of Generators, Kw.	Hydro: No. of Plants	Hydro: Nameplate Rating of Generators, Kw.	Source of Energy, 1940, Thousands of Kw.-Hr.: Generated, Net	Received by Purchase or Interchange, Net	Total Input, Net
Rocky Mountain States							
Bureau of Reclamation, Boulder Dam	0	0	1	704,800	3,072,604	0	3,072,604
The Montana Power Co.	0	0	14	349,750	1,712,088	1,663	1,713,751
Utah Power & Light Co.	6	61,970	29	178,192	692,170	383,888	1,076,058
Idaho Power Co.	2	612	13	105,610	717,997	27,394	745,391
Public Service Co. of Colorado	12	114,507	10	42,975	514,904	30,864	545,768
Salt River Valley Water Users' Assn.	1	10,000	8	70,950	168,004	281,047	449,051
Central Arizona Light & Power Co.	2	43,000	0	0	162,320	17,927	180,247
Totals for section	23	230,089	75	1,452,277	7,040,087	742,783	7,782,870
Pacific States							
Pacific Gas and Electric Co.	10	479,625	49	882,441	4,689,287	1,368,987	6,058,274
Southern California Edison Co., Ltd.	4	399,000	24	576,020	3,590,755	63,641	3,654,396
City of Los Angeles. Dept. of Water & Power	3	187,500	6	440,605	1,884,172	9,895	1,894,067
Puget Sound Power & Light Co.	3	94,500	12	193,190	1,202,704	42,922	1,245,626
The Washington Water Power Co.	0	0	12	203,534	1,112,013	104,258	1,216,271
Portland General Electric Co.	3	90,000	7	93,465	546,585	296,372	842,957
The California Oregon Power Co.	1	15,000	12	100,080	624,475	18,594	643,069
City of Seattle, Dept. of Lighting	1	30,000	4	219,256	592,683	17	592,700
Hetch Hetchy Pwr. & Uti. Engr. Bureau	0	0	2	83,000	528,727	0	528,727
Northwestern Electric Co.	2	42,500	1	9,600	253,860	248,271	502,131
City of Tacoma. Dept of Public Utilities	2	34,000	3	114,000	432,449	68,959	501,408
The Nevada-California Electric Corp.	2	8,135	8	48,875	240,365	179,039	419,404
Bonneville Power Administration	0	0	1	140,400	374,176	440	374,616
San Diego Gas & Electric Co.	1	99,000	0	0	290,946	35,014	325,960
Pacific Power & Light Co.	1	10,000	10	21,967	156,758	165,125	321,883
Inland Power & Light Co.	0	0	2	45,800	227,045	8,060	235,105
Mountain States Power Co.	16	15,111	7	6,686	59,791	154,395	214,186
Turlock-Modesto Irrigation Districts	1	1,000	2	31,000	177,453	1,510	178,963
PUD No 1, Cowlitz Co., Wash.	1	27,000	0	0	169,521	—4,164	165,357
Merced Irrigation District	0	0	1	31,250	128,530	0	128,530
East Bay Municipal Utility District	0	0	1	15,000	104,003	0	104,003
Totals for section	51	1,532,371	164	3,256,169	17,386,298	2,761,335	20,147,633

Table III. Summary of generator rating and output of large utility systems, 1940

(From *Electrical World,* May 3, 1941)

Region	No. Cos. or System	Number of Generating Plants and Generator Rating — All Plants — Number	All Plants — Rating, Kw.	Fuel Plants — Number	Fuel Plants — Rating, Kw.	Hydro Plants — Number	Hydro Plants — Rating, Kw.	Energy Generated (Net) Thous. Kw.-Hr.	Rec'd by Purch. or Interchange Thous. Kw.-Hr.	Output Gen. and Purch. Thous. Kw.-Hr.
United States	**155**	**1,717**	**35,584,122**	**810**	**24,858,949**	**907**	**10,725,173**	**130,933,103**	**17,253,166**	**148,186,269**
New England	18	203	2,553,973	47	1,743,337	156	810,636	8,152,190	1,870,538	10,022,728
Middle Atlantic	22	296	9,576,134	128	7,742,290	168	1,833,844	36,016,000	2,985,272	39,001,272
East North Central	28	297	8,505,620	133	7,919,148	164	586,472	31,628,898	2,190,650	33,819,548
West North Central	17	210	2,618,756	130	1,966,041	80	652,715	8,302,350	257,174	8,559,524
South Atlantic	16	144	2,186,987	88	1,454,313	56	732,674	7,467,495	2,603,962	10,071,457
East South Central	8	76	1,881,858	51	613,413	25	1,268,445	8,172,332	2,969,948	11,142,280
West South Central	18	178	1,789,888	159	1,657,947	19	131,941	6,767,453	871,504	7,638,957
Mountain	7	98	1,682,366	23	230,089	75	1,452,277	7,040,087	742,783	7,782,870
Pacific	21	215	4,788,540	51	1,532,371	164	3,256,169	17,386,298	2,761,335	20,147,633

1944 and shortly thereafter 75,000 kw. should be available from Keswick and 300,000 kw. from Shasta Dam of the government's Central Valley project. This assures the region of ample capacity for normal and defense loads.

PACIFIC NORTHWEST

In the Pacific Northwest, the picture is one of power in abundance for any defense need, thanks principally to the bounteousness of the federal treasury. Utilities of that area now have at their disposal two huge reservoirs of low-cost, tax-free government power. At Bonneville within the recent months, two additional 54,000-kw. generators have begun production, principally for the purpose of supplying power to the Aluminum Company of America at Vancouver, Wash. Two more machines of the same size will be ready early in August and December and the final four of the ten ultimately to be installed will be under construction. The real boost to the power resources of the Northwest will occur late this year and early next year when three 108,000-kw. generators will begin operating at Grand Coulee Dam. (August, November and January, respectively.) Within the next seven months a total of 432,000 kw. of additional capacity will be made available in that region. In the meantime, the serving utilities are readying their transmission and distribution facilities to permit marketing as much of this power as the area can absorb.

UTAH-IDAHO

In the Utah-Idaho region, the three major utilities in that area—Utah Power & Light, Idaho Power and Montana Power—have built a 277-mile transmission line interconnecting those three systems. This will place at the disposal of the Utah and Idaho companies, 35,000 kw. of the present excess resources of Montana Power and at the same time will give them access through interchange to some of the great surplus in the Pacific Northwest. Montana Power already is tied into the Northwest power pool and can draw at any time on the Grand Coulee-Bonneville surplus.

This quick resume of the power situation in the Pacific Coast region has been made in an endeavor to emphasize two specific points: (1) the long established policy of being prepared at all times to provide adequate electric service to their customers is still a primary tenet of the western electric utilities. (2) Any abnormal power demands imposed upon their systems by the national defense emergency will be met fully and efficiently. The electric power industry in the West is prepared.

FAVORABLE RATES

Because of favorable electrical characteristics, most electrochemical and processing industries command premium rate schedules. Often, too, their load characteristics permit favorable combinations of firm and secondary (dump) power—the latter representing merely the utilization of flood waters that would otherwise be spilled over the dams.

The rates established in 1938 by the Bonneville-Grand Coulee Power Administration, with the approval of the Federal Power Commission, are \$14.50 per kw.yr. (1.65 mills per kw.hr. at 100 percent load factor) for primary power and \$9.50 for secondary power at the dam-site and \$17.50 (2 mills per kwh. at 100 percent load factor) and \$11.50, respectively from any point on the extensive transmission system of the region which is shown in the accompanying map along with 1942 projections.

FUTURE DEVELOPMENTS

The pattern of future power development of the Bonneville-Grand Coulee area is pictured in an article in *Business Week* of August 2, 1941. This shows more than tenfold increases in installed capacity plans for the next four years. For the country as a whole, if the Federal Power Commission has its way, our present generating capacity of about 42,000,000 kw. will be pushed to 50,000,000 kw. next year and by 1946, will reach 62,000,000 kw. Locations and capacities of the new power plants which F.P.C. has planned for the 11 Western States is shown in the accompanying map (Fig. 3). Reference has already been made to the map in Fig. 1 showing where the Pacific Northwest will help in national defense after present plants and those now proposed get into full operation.

Raw Materials and Natural Resources

Chem. & Met., especially in its August, 1935, and September, 1938, issues, has already presented an exhaustive survey of the abundant mineral and agricultural resources of the 11 Western States, which are of prime interest to the chemical process industries. There is little necessity, therefore, for repetition here except perhaps to summarize briefly the results of some of the raw material surveys that have been made by local, state and national agencies in recent months, especially in connection with the National Defense Program.

By way of a starting point, however, it seems desirable to reprint in Table IV the location and status of mineral resources in the 11 Western States which was compiled for *Chem. & Met.* in September, 1938, largely by Ray M. Miller now a member of the System Planning and Marketing Division of the Bonneville Power Administration in Portland, Ore. We shall want to draw heavily, too, on that organization's more recent study of the availability of resources and raw materials that are of current interest in connection with national defense.

Among the mineral resources that have been reviewed in prior Pacific

Coast issues of *Chem. & Met.*, perhaps the most important are petroleum, borax, potash, clays, diatomite, salines, mercury, magnesite, bromine, iodine, and cement. Lesser attention has been given to abrasives and clays, antimony, chromite, copper, gold, lead, silver, zinc, limestone, coal, manganese and molybdenum. Attention has been called to the fuel situation, particularly as regards petroleum and natural gas in California, coal in Washington and Oregon, and the vast amount of byproduct fuel from the lumber industry of the Pacific Northwest. Agricultural resources include in addition to the sugar beet crop, cereals, etc., the cull fruits and wastes that are available from the California fruit industry.

IRON AND STEEL

Although there are seven open-hearth steel plants and one blast furnace plant on the Pacific Coast, the present capacity for the production of iron and steel is not sufficient to meet local demands. This deficiency must be made up in overland and inter-coastal shipments from iron and steel producing centers elsewhere in the nation. Hence a great deal of attention has been given to the possible development of iron ore, limestone and coke resources on the West Coast, particularly in the Pacific Northwest. Iron ore deposits of considerable importance are available in Northeastern Washington, Northern California, and British Columbia. Wood for charcoal production and wood coke is available in adequate amounts in Washington and Oregon as sawmill waste. Petroleum coke is available from a number of petroleum refining operations and in Portland from the gas operations of the Portland Gas & Coke Co. Coking coal, available in Western Washington, has not been developed sufficiently to warrant immediate use. Limestone is available both in Oregon and Washington as well as in the San Juan Islands in the Puget Sound and on Dall Island in Alaska. Scrap iron and steel would be available in a considerable quantity on the Pacific Coast, especially now that foreign exports are shut off.

Western iron ores are mainly magnetites containing 60 to 80 percent of iron. Some are very low in phosphorus and sulphur and are available in sufficiently large deposits to warrant the possibility of commercial development. Northern Washington, British Columbia and Southern California are the most likely sources, although the limonite deposits in Oregon and the magnetite ore bodies of Nevada, Idaho and Montana have been receiving attention. In Lower California (Mexico) there are many deposits of iron ore, principally hematites available at tidewater. If the copper ores of the Kasaan Peninsula in Alaska were thoroughly developed, considerable byproduct magnetite might be separated from the copper sulphides.

A byproduct oven recently established in British Columbia utilizes coking coals available in the Crows Nest and Elk River fields of that province. Centers of waste wood supply available for charcoal manufacture are: (1) Lower Columbia River near Portland; (2) Puget Sound near Tacoma; and (3) Willamette River near Salem, Ore.

The Northwestern States are well supplied with limestone of high purity suitable not only for fluxing purposes but also for lime and calcium carbide manufacture. The four principal areas accessible to the Columbia River power projects and Puget Sound are (1) Southwestern Oregon; (2) Northeastern Oregon; (3) Northeastern Washington; (4) Northwestern Washington. There are many other sources where both high-

Pacific Coast sources, raw materials and chemicals for rayon and plastics production

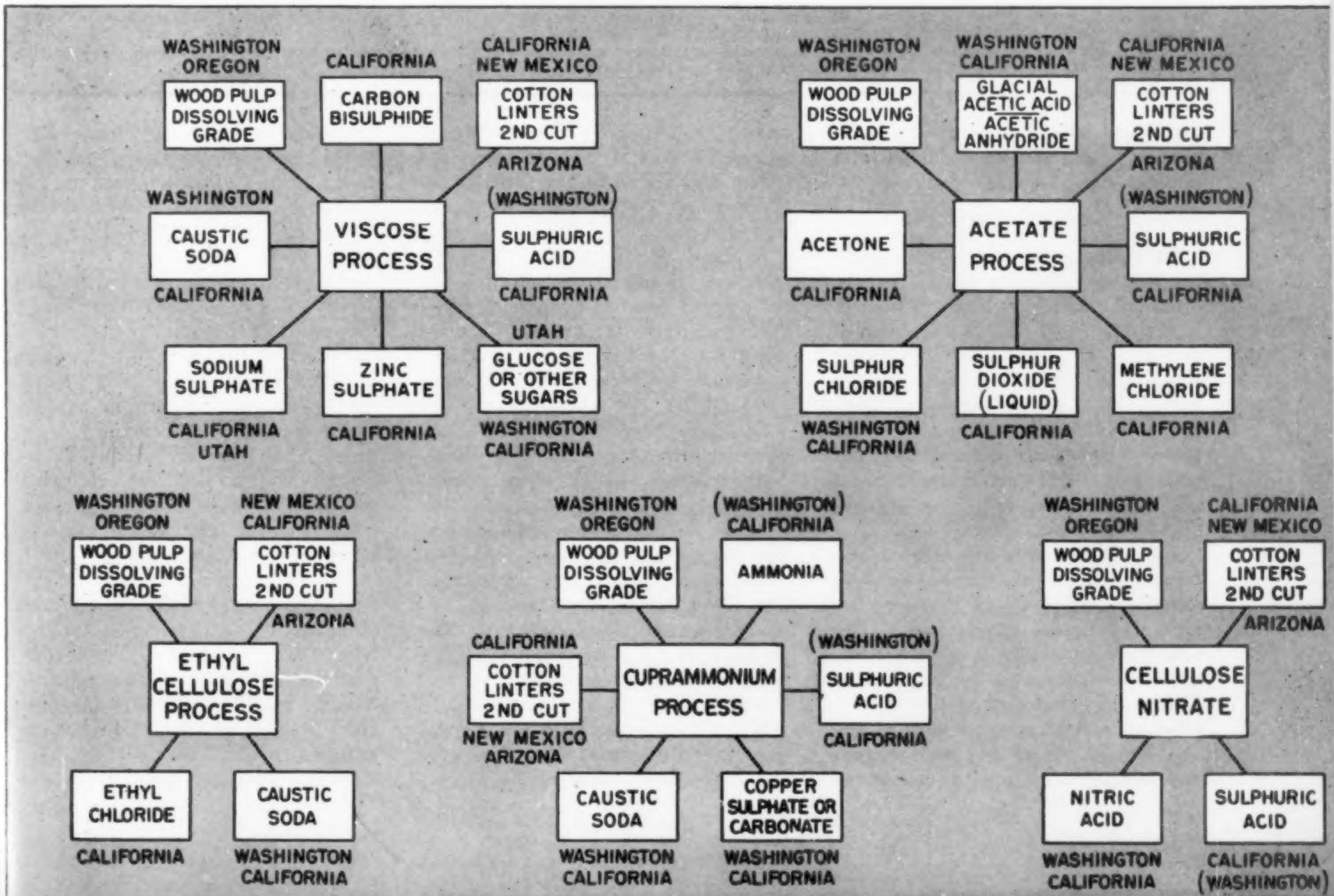


Table IV. Location and status of mineral resources in the eleven Western States*

Mineral	New Mexico	California	Washington	Colorado	Wyoming	Montana	Nevada	Arizona	Oregon	Idaho	Utah
Antimony	X	XX	X	X	....	X	XXX	X	X	XXXX	XXX
Arsenic	X	XX	X	....	....	XXXXX	X	X	....	X	X
Asbestos	....	XX	X	X	XXXX	X	....	X	X	X	....
Beryllium	....	X	....	XX	X	....	X	....	....	X	X
Chromite	....	XXX	XX	....	XXX	XX	....	....	XXXXX	....	....
Clays	XXX	XXXX	XXXXX	XXX	XXX	XXX	XX	XXXX	XXX	XXXXX	XXXX
Cobalt	....	X	X	X	X	....	X	X	X	X	....
Copper	XXXXX	XXXXX	XXXXX	XXXX	XX	XXXXX	XXXXX	XXXXX	XX	XXX	XXXXX
Gold	XXXX	XXXXX	XXXX	....	XXX	XXXXX	XXXXX	XXXX	XXXXX	XXXXX	XXX
Feldspar	....	XXX	XX	....	XX	....	XX	XXX	....	X	XX
Graphite	X	XX	XX	XX	XXX	X	X	....	X	XX	....
Iron	XXXX	XXX	XXX	XXXXX	XXXX	X	X	XX	XX	X	XXXX
Lead	XXX	XXX	XXX	XXXXX	X	XXXXX	XXXX	XXXX	X	XXXXX	XXXXX
Limestone	XXX	XXX	XXX	XXXX	XXX	XXX	XXXX	XX	XXXX	XX	XXXX
Magnesite	....	XXXX	XXXXX	....	....	....	XX	....	....	....	....
Magnesium Sulphate	....	XXX	XX	....	XX	....	....	....	....	....	....
Manganese	X	XXX	XX	X	X	XXXX	XX	XX	XX	XX	XX
Mercury	....	XXXXX	X	....	....	....	XXXX	....	XXXXX	XXX	X
Mica	X	XXX	X	XXX	XXX	XXX	XX	X	X	XXXX	....
Molybdenum	XX	XX	XX	XXXXX	X	X	XXX	X	X	X	XX
Platinum	....	XXX	X	X	X	X	XX	X	XX	....	X
Potash	XXXXX	XXXXX	....	X	....	....	XX	X	....	....	XX
Pumice	X	XXX	X	....	XX	....	....	....	X	X	X
Silica	....	XXX	XX	....	....	X	XX	....	....	X	....
Diatomite	....	XXXXX	XX	....	....	X	....	XXX	XXXXX	XX	XX
Silver	XXX	XXXXX	XXX	XXX	XXXX	XXX	XXXXX	XXX	XXX	XXXXX	XXXX
Sodium Carbonates	....	XXXXX	XX	....	XX	....	....	....	X	....	....
Sodium Sulphate	....	XXXXX	XXX	....	XXXX	....	XXX	XX	....	....	....
Sulphur	X	XX	X	X	XXXX	XXX	....	....	....	XX	X
Talc	....	X	X	....	....	....	....	....	X	XX	....
Tungsten	XX	XXXX	XXX	X	X	XXX	XXXXX	XX	....	XX	XXX
Vanadium	X	X	XX	X	....	X	XX	XXX	....	....	X
Zinc	XX	XXX	XXX	X	XXX	XXXXX	XXXX	XX	XX	XXXXX	XXXXX
Salt	X	XXXX	....	....	XX	....	XX	X	X	XX	XXXX
Borax	....	XXXXX	....	....	....	....	XX	....	....	....	....
Brucite	....	....	....	....	....	....	XXX	X	....	....	....
Barite	X	XXX	XX	....	XX	XXX	X	X	X	XX	X
Celestite	....	XX	XX	....	....	....	....	XX	X	....	X
Cement Rock	XX	XXX	XXX	XXXX	XXX	XXXX	XX	XXX	XXXX	XXX	XXX
Gypsum	X	XXX	....	X	XXX	XXX	XXX	X	XX	XX	XXXX
Fluorspar	X	XXX	X	XXXX	X	....	XX	XX	....	....	....
Bismuth	X	X	X	X	X	X	X	X	....	....	X
Cadmium	....	X	X	XXXX	....	XXXXX	....	....	....	XXXXX	XXXXX
Nickel	X	X	X	X	X	....	X	....	X	X	....
Tin	X	XX	X	X	X	....	....	....	....	X	....
Titanium	....	XX	....	X	XX	....	....	....	XXX	....	....
Pyrites	X	XXX	X	....	XX	XX	XXXX	XXXXX	XXX	XX	XX
Soapstone	....	XXX	X	....	....	....	....	....	....	....	....
Potash	XXXXX	XXXXX	....	....	....	....	....	....	....	....	XX
Bromine	....	XXXXX	....	....	....	....	X	X	....	....	....
Phosphate Rock	....	....	....	....	XX	XXXX	....	....	....	XXXX	XX

KEY: **X**, present but extent unknown; **XX**, some past production but not now operating *or* with undeveloped possibilities; **XXX**, producing or undergoing development; **XXXX**, fairly well developed industry; **XXXXX**, well developed.

* This chart has been prepared from information available in a large number of private and governmental reports, private communications, etc., with the aid of R. M. Miller formerly of Industrial West, Inc., and now with Bonneville Power Administration.

grade and low-grade stone are available in Idaho, British Columbia and Southeastern Alaska.

FERRO-ALLOYS

Of more immediate importance to the National Defense, particularly to ordnance manufacture, to shipbuilding, to aircraft construction including engines, and to the equipment requirement of the chemical process industries, is the production of high-grade iron and alloy steels. Since these materials are most often products of the electric furnace, there is additional reason for their production in the West.

Ferro-manganese, ferro-silicon and ferro-chromium are the three most important ferro-alloys required for high-grade steel production. The ores for all of these alloys are present in or accessible to the Pacific Northwest. Other important ferro-alloying metals also present in the 11 Western States are molybdenum and tungsten, as well as some vanadium and nickel. The Northwest cannot be said to have adequate reserves of manganese but deposits do occur in unknown amounts in Washington, Oregon, California, Nevada, Utah and Montana. In general, these are low-grade ores unsuited for the present ferro-manganese production methods. Important work is being done by the Bureau of Mines and other agencies to develop these potentialities.

Chromite deposits are located in five western states, namely: California, Oregon, Washington, Montana and Wyoming. They occur to a minor extent as high-grade ores, but largely as low-grade, requiring considerable mechanical concentration as well as selective mining. Attention has also been given to the possibilities of developing large known chromite resources in the Philippine Islands and in Alaska.

Molybdenum occurs in the Northwest in Washington, Oregon, Idaho and Montana. However, the principal source of the United States supply of molybdenum is in Colorado at the great Climax mine of the Climax Molybdenum Co., which is now supplying nearly 80 percent of the entire world's production.

Although the United States has been heavily dependent upon foreign sources of tungsten, chiefly China, the Western States have lately demonstrated their capability of producing a large proportion of the requirements of this country. The principal sources of tungsten in the United States are Nevada, California, Colorado and Washington, while Arizona and Idaho are also reporting some production.

The United States normally produces about half of its consumption of vanadium, importing the balance from Peru. Present U. S. production comes from Colorado, Arizona, Nevada and Utah. No occurrences are reported in the Pacific Northwest, but Idaho, Utah, Wyoming and Montana phosphate beds are known

to contain vanadium in small percentages and some production is being obtained as a byproduct of fertilizer manufacture where these ores are utilized commercially.

MAGNESIUM'S RAW MATERIALS

Brines, sea water and magnesite, which are the present sources of magnesium metal in the United States and foreign countries, are all available in abundance in the 11 Western States.

The saline deposits underlying several lakes in Okanogan County, Wash., have been mined commercially for magnesium sulphate. The waters of Great Salt Lake, Utah, contain significant quantities of magnesium salts, chiefly magnesium chloride. According to the late F. W. Clarke, of the U. S. Geological Survey, the waters of the lake analyze 24 percent of solids of which 2.5 percent is magnesium. Consequently, Mr. Miller and his associates have calculated that every 50,000 gal. of Great Salt Lake water contain 1 ton of magnesium metal or 3.92 tons of magnesium chloride. More recent analyses show even greater concentrations.

Sea water has long been the direct source of magnesium derivatives at the plant of the Marine Magnesium Products Co., Ltd., on South San Francisco Bay, and indirectly has furnished the raw material for the sea water bitterns used by the Westvaco Chlorine Products Corp., in its operations at Newark, Calif.

The newer electrothermal reduction processes for magnesium production serve to re-emphasize the importance of magnesite and brucite deposits. In Washington, near Chewallah in Stevens County, crystalline magnesite associated with dolomite is found in a widely spaced chain of deposits. Within a range of 20 miles the mineral occurs at ten places and other deposits are indicated. Analysis of the higher grades range from 40.9 to 47.2 percent of magnesia, up to 7.14 percent silica, up to 1.15 percent iron oxide, and up to 6.88 percent of lime. To date these materials have been developed primarily for the production of magnesite refractories.

In California, magnesite is known in 22 counties in the central part of the state. Commercial shipments have been made from many scattered localities over a long period of years and substantial reserves are known to exist, although recent figures are not available on totals or on individual properties.

Brucite which is the natural hydrate of magnesia, exists near Luning in Nevada in large volumes and of great purity. It is mined by the Basic Ore, Inc., a subsidiary of Basic Dolomite, Inc., of Cleveland, Ohio, and will be utilized in the future production of magnesium metal in a great program projected by the government in cooperation with this organization. It is also one of the important sources to be utilized in the Permanente development by the Kaiser interests in California. Franke (See *Chem. & Met.*, March 1941, p. 75-7) estimates the brucite reserves near Luning at 3,350,000 tons. Pure brucite ($Mg(OH)_2$) contains 41.6 percent magnesium, so it is conceivable that this large body of ore alone could yield many thousands of tons of the pure metal.

McIndoe of the Bonneville Power Administration (see *Chemical Industries,* August 1941, pp. 162 to 170) also calls attention to olivine, the natural magnesium silicate of which large potential resources have recently been explored in the Twin Sisters Mountains, Whatcom and Skagit Counties in Washington. A second deposit occurring on Cypress Island in Puget Sound, is said to be of excellent refractory grade and readily accessible by water barge transportation. Pure olivine (dunite) contains 47 percent of magnesia, 41 percent of silica, 10 percent of iron oxide, and small amounts of alumina and chromite.

The tremendous tonnage of these magnesium materials would seem to put the West into a premier position for further development of the magnesium industry, particularly when considered in connection with the phenomenal power resources, the proximity to large-scale aluminum production and, finally, the great and growing market in West Coast airplane manufacture. It has been estimated that an average attack bomber, including the engine, contains 800 lb. of magnesium in alloys, 13,000 lb. of aluminum, 550 lb. of stainless steel, and 4,000 lb. of alloy steels.

Technical Man-Power

WESTERN CHEMICAL and process industries draw their technically trained personnel largely from 16 colleges and universities giving courses in chemical engineering and from 7 additional colleges giving courses with major in chemistry. In an article in a recent issue of the *Journal of Engineering Education* (Dec. 1940, pp. 264 ff.) were published some statistics which may be used to evaluate the potential supply of technically trained men in this area and in the United States as a whole.

Statistics for the United States as a whole have been abridged to give the summary shown in Table V and the data for the Western States appear in Tables VI and VII.

It will be noted that of the classified engineering curricula, mechanical, chemical, electrical and civil engineering lead in number of students in the order named, with mechanical engineering almost doubling its nearest competitor. In graduate enrollment, electrical, chemical and mechanical are nearly equal, but are arranged in this order, each representing about 20 percent of the total enrollment in graduate schools. Chemical engineering leads with almost double the number of Ph.D. candidates who received their degrees in the collegiate year 1939-1940, according to this same article.

What figures are available for the institutions of higher education in the 11 Western States give the in-

Table V. Engineering Enrollments in U. S. During Collegiate Year 1940-1941

(From Journal of Engineering Education December 1940, p. 204)

Engineering Course	Freshman	Sophomore	Junior	Senior	Fifth	Other Incl. Night School	Total
Aeronautical ...	1,150	1,009	750	528	71	215	3,723
Agricultural ...	271	189	212	187	4	1	864
Architectural ..	310	313	239	234	15	8	1,119
Ceramics	199	172	151	171	...	37	730
Chemical	4,002	4,309	3,528	2,784	222	1,332	16,177
Civil	2,499	2,794	2,575	2,226	124	934	11,152
Electrical	3,185	4,035	3,477	2,913	161	1,734	15,505
Industrial	320	692	632	590	62	146	2,442
Mechanical	7,185	7,370	6,007	4,532	286	3,229	28,609
Metallurgical ..	385	537	603	497	3	251	2,276
Mining	578	534	595	547	11	29	2,294
Unclass. Miscel..	13,666	2,722	1,659	1,433	83	6,164	25,727
	33,250	24,676	20,428	16,642	1,042	14,080	110,618

Table VI. Enrollment in Engineering Courses in Eleven Western States

School	Fresh-man	Sopho-more	Junior	Senior	Grad-uate	Other	Totals	Degrees 1939–40
Univ. of Cal.	370	334	633	531	..	8	1,876	302
Univ. of So. Cal.	69	82	102	88	..	415	756	66
Calif. Inst. Tech.	160	87	126	101	48	..	522	131
Colo. State Col.	108	78	60	48	..	..	294	45
Colo. Sch. Mines	207	224	185	157	..	..	773	147
Univ. of Colo.	310	209	188	160	..	..	867	143
Univ. of Idaho	166	101	86	56	..	..	409	67
Montana St. Coll.	186	140	74	73	..	..	475	75
Mont. Sch. of Mines	86	88	62	54	..	..	290	..
Univ. of Nevada	63	61	57	40	..	..	221	..
Univ. of N. Mex.	111	72	38	30	..	..	251	19
N. Mex. A. & M.	71	32	39	40	..	..	182	19
Oregon St. Coll.	376	252	202	131	..	..	961	119
Santa Clara Univ.	32	22	20	8	..	..	82	9
Stanford Univ.	110	100	94	113	..	..	417	74
Utah Agri. Coll.	67	60	46	39	..	..	212	..
Utah Univ.	156	182	108	69	..	..	515	..
Univ. of Wash.	689	208	273	276	..	..	1,444	176
Wash. St. Coll.	215	149	126	139	..	..	629	80
Univ. of Wyoming	125	103	67	62	..	2	359	38
Univ. of Denver	71	39	22	20	..	..	152	21
Univ. of Arizona	119	105	94	58	..	7	383	45
Gonzaga Univ.	71	45	22	14	..	..	152	2
Total	3,938	2,773	2,724	2,307	48	432	12,222	1,578

Table VII. Graduate Engineering Enrollment, 1940-41, in Eleven Western States

School	Masters Total	1939–40 Degrees	Ph.D. Total	1939–40 Degrees
Univ. of Arizona	8	3	..	..
California Institute of Technology	103	57	26	10
University of California	113	37	..	2
University of Southern California	25	10	..	..
Colorado School of Mines	14	7	..	..
Colorado University	56	14	..	..
University of Idaho	5	9	..	..
Montana School of Mines	16	10	..	..
Montana State College	2	1	..	..
Oregon State College	12	1	..	..
Stanford University	96	28	..	..
Utah Agricultural College	2	0	..	..
Utah University	5	4	..	..
Washington State College	3	0	..	..
University of Washington	22	14	..	..
University of Wyoming	1	0	..	..
Total Western States	483	195	26	12
Total United States	4,582	1,318	623	108

formation shown in Table VI and the graduate engineering enrollment in Table VII. It will be noted that the University of California leads in the undergraduate engineering enrollment, the University of Washington is second, and Oregon State College is third. California Institute of Technology granted more graduate degrees than any other Western institution in 1939-40, closely followed by the University of California and Stanford University.

Although in general the western schools listed in these tabulations do not offer as large a variety of engineering courses as may be the case with eastern institutions, the standards are high and the training is believed to be quite adequate to serve existing needs. Curricula accredited by the Engineers' Council for Professional Development are available in most instances, although only three of the schools have to date been accredited in chemical engineering.

No reliable figures are available on the total number of chemists and chemical engineers in the 11 Western States. Table VIII is a tabulation of the membership in the American Chemical Society and in the American Institute of Chemical Engineers in this area as revealed by the society directories for 1940.

Table VIII. Chemical and Chemical Engineering Society Membership

State	A.C.S. Members	A.I.Ch.E. Members
Arizona	23	..
California	1,358	80
Colorado	122	12
Idaho	27	1
Montana	43	5
Nevada	18	2
New Mexico	28	1
Oregon	98	5
Utah	48	1
Washington	172	17
Wyoming	20	1
Total	1,956	125

Equipment Resources

PRACTICALLY ALL of the various types of equipment used in the chemical process industries of the West are manufactured in that territory. Included are pumps, filters, flotation equipment, evaporators, dryers, dust collectors and classifiers, fans, heat exchangers, cooling towers, distillation equipment, conveyors, etc.

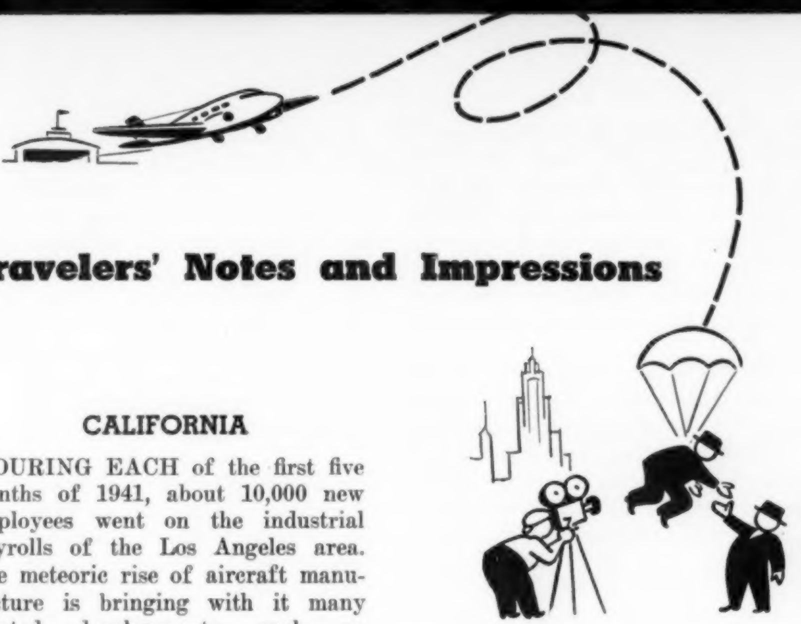
In a number of lines, western manufacturers have moved into a dominating position throughout the United States. As pointed out previously, this has been largely due to the fact that the requirements for such important western industries as mining and metallurgical production, petroleum refining, canning and preserving of food products, were such that comparable developments followed among the manufacturers that supplied necessary equipment and accessories. As these developments proceeded, often independent of practice and technique of eastern manufacturers, a certain number naturally grew in importance and influence until they were soon serving a national market.

It is not at all unusual to find headquarters on the Coast for important equipment companies that serve eastern markets directly or through branch plants in the Middlewest and Middle Atlantic States. Thus we have almost the reverse of what has happened to their customer-industries.

In addition to the manufacture of standard types and sizes of equipment, a number of fabricators have the necessary staffs and facilities for engineering, designing and manufacturing the special types of equipment so frequently required in the chemical process industries. Many manufacturers of standard sizes and types of equipment are especially desirous of handling the so-called "custom jobs." Production of ferro-alloys and high-grade electric furnace steel, a relatively new industry in the West, will doubtless increase equipment manufacturing facilities.

Makers of process equipment, on the whole, are anxious to keep their business as diversified as possible. During normal times, when raw materials are obtainable, chemical manufacturers will find that practically any kind of process equipment can be produced or is readily available in the 11 Western States.

The balance of this report is concerned with travelers' notes and personal impressions of some of the more important developments in the chemical process industries of the West which have occurred since the last *Chem. & Met.* Regional Report in September 1938.



Travelers' Notes and Impressions

CALIFORNIA

DURING EACH of the first five months of 1941, about 10,000 new employees went on the industrial payrolls of the Los Angeles area. The meteoric rise of aircraft manufacture is bringing with it many related developments, such as the new fabricating plants for aluminum and magnesium alloys, molding plants for plastics, new or expanded facilities for paint and varnish, compressed gases, carbon products, foods, drugs and pharmaceutical preparations. Curtailment of ocean and coast-wise shipments of chemicals from eastern producers has created an opportunity for increased production in the local plants.

OPM's tentative selection of the Los Angeles-Boulder Dam area as a site for the 70,000,000 lb. aluminum plant which the Bohn Aluminum & Brass Co. is to build and operate for the Defense Plant Corporation, serves to emphasize the availability of adequate power at reasonable rates from either hydro- or fuel-generated sources.

Up in the area around San Francisco Bay, the attention that has been given to the Hansgirg process (see pp. 91 to 94 of this issue) and Henry Kaiser's new magnesium plant at Permanente, has tended to overshadow important and related developments by Westvaco Chlorine Products Corp. at Newark and the Marine Magnesium Products Corp. of South San Francisco. Since we visited the former plant in 1938, a third magnesia kiln has been added. It operates on ore obtained from a Nevada property jointly owned by Westvaco and Permanente. The former also operates a kiln in the Permanente plant inclosure for producing magnesia values for its own use and for the future supply of the Permanente magnesium metal plant. At its Patterson, Calif., plant, Westvaco uses Nevada ore for making high grade refractories.

A lot of interest is being shown in the use of magnesia or magnesium carbonate to replace lime or limestone in sulphite pulp plants in the Pacific Northwest. Clarke of Marine was one of the pioneers in this development. His company, which was the first to make magnesia directly from sea water, has recently developed several ingenious processes for its direct reduction to metal using calcium carbide as the reducing agent.

At Pittsburg, Calif., Dow's Great Western Division is proudest of its new chlorination plant that went into operation April 24th of this year. It is the culmination of eight years of experimental work on the chlorination of natural gas. The first plant made principally carbon tetrachloride with incidental production of methylene chloride, chloroform, and hexachlorethane. Changing demands have since made it necessary to shift primary emphasis to the lower chlorinated compounds, such as methyl chloride. Auxiliary units have been added to take care of additional requirements for hexachlorethane and perchlorethylene. The greatly increased production of byproduct hydrochloric acid must find additional West Coast markets or new applications in the Great Western plants. That's how chemical industries grow, isn't it?

R. E. Fisher of Pacific Gas & Electric Co. in San Francisco, had some good ideas for the future development of the Bay area. He foresees greater chemical as well as fuel utilization for the byproducts of the petroleum refineries and from natural gas. He cites Hercules Powder Co.'s new synthetic ammonia plant as a desirable type of West Coast development. Lists electrolytic zinc (with sulphuric acid as a byproduct) magnesium, ferro-alloys, calcium carbide and plastics as projects under negotiation and study.

OREGON

PORTLAND, unless we miss our guess, is shortly to become the chemical and metallurgical capital of the West—certainly of the Pacific Northwest. Within a matter of months, one after another of the larger companies in these fields have purchased sites and announced plans for new plants that are completely changing Portland's economy from an agricultural and lumbering community into a thriving industrial center.

All this has followed what for years was know as "Dodson's dream"—the vision of the veteran head of Portland's Chamber of Commerce who fought so long and hard for "cheap power at tidewater." That dream was realized with the completion of Bonneville Dam and the practical harnessing of the great "River of the West." *

Much credit is justly due to the Bonneville Power Administration for its thorough studies and promotional work with industries. But the private utilities have taken the lead in bringing new year-around payrolls to the Portland Metropolitan area and the Columbia River Basin.

Here are some of the results of this new aggressiveness by the citizens of Portland:

New Chemical and Metallurgical Plants in Portland Area and Approximate Investments Involved

Aluminum Co. of America	$18,000,000
Reynolds Metals Co.	10,000,000
Projected Magnesium plant	1,500,000
Pennsylvania Salt Mfg. Co.	800,000
Portland Gas & Coke Co.	1,500,000
Electro Metallurgical Corp.	2,000,000
Pacific Carbide & Alloys Co.	1,000,000
Stauffer Chemical Co.	100,000
General Chemical Co.	75,000
Zenith Powder Co.	25,000
OPM Aluminum plant (Alcoa operated)	7,500,000
Partial Total	$42,500,000

Several additional plants for electrolytic zinc, ferro-silicon, ferrochromium and lead are under consideration but no announcements have yet been made.

According to H. W. Derry, manager of the new industries department of the Pacific Power & Light

* Incidentally that's the title of a glamorous 50-page book by Robert Ormond Case, nationally known author, which has been widely circulated in recent months by H. W. ("Bill") Derry, manager of Pacific Power & Light Co.'s new industries department in Portland.

Co., five nationally known firms are making estimates and plans to build and operate a large magnesium plant in the Portland area which will cost about $1,500,000.

Before its new sodium chlorate plant at Portland was half completed, Pennsylvania Salt Mfg. Co. announced plans for doubling its capacity. Operations are scheduled to start this Fall.

Portland Gas & Coke Co. will add 6,000,000 cu.ft. to its daily gas capacity in its new $1,500,000 addition to its chemical and gas manufacturing plant (see article this issue pp. 100 to 105). This will increase its output of valuable byproducts, yielding in addition to petroleum coke of the type used in aluminum production, benzol for motor fuel, toluol, xylol and naphthas for solvents and chemical uses, and the olefine hydrocarbons that may well form the basis for new organic chemical industries.

Electro-Metallurgical Co., unit of Union Carbide and Carbon Corp., plans to place three electric furnaces in operation by January 1 in its $2,000,000 plant just now getting under construction. Production will include ferro-silicon, ferro-chrome, ferro-alloys, carbide and other electric furnace products using, in certain instances, raw materials shipped from the Philippines and Alaska.

Pacific Carbide & Alloys Co. plans to double the size and capacity of its Portland plant which has been in operation for a year with main production concentrated on acetylene and calcium carbide. Stauffer Chemical Co. already has plans for expansion, although ground has just been broken for its new plant in the Portland area. The company will produce aluminum sulphate or paper-maker's alum for the paper mills in the Pacific Northwest and for use in water purification. Aluminum sulphate will also be the principal product of the General Chemical Co.'s new plant now building in Vancouver, across the Columbia River a short distance from Portland.

Plywood is an industry of growing importance in the Portland area and one in which chemicals are playing a more important part. During the past two years five new plywood plants, representing an investment of more than $4,000,000, have been located in the Willamette Valley—all within 120 miles of Portland. The plywood industry is on the move to areas where "peeler" logs are available and they have been found in great quantities on the Western slopes of the Cascade Range which forms the eastern border of the Willamette Valley and in the Coast Range which forms its western border.

Oregon is not ordinarily regarded as a mining state yet in 1940 it produced about $4,000,000 in gold and $1,600,000 in mercury. The largest mercury operation in the United States is said to be the Bonanza mine near Sutherlin, which produces 500 flasks a month. Horse Heaven Mine of the Sun Oil Co. in the Ochoco forest is producing 165 to 175 flasks a month. Increased production of diatomaceous earth in the new mine and plant at Terrebonne is described on pp. 114 to 115 of this issue.

Chemurgy has made its start and has a big opportunity in Oregon. Soybean oil, potato starch, flax for linen and oil, sugar beets, casein and whey, fish oils and byproducts, botanical drugs—these are a few materials already being produced or are projected for the near future. Thus the better balance between farm and factory is certain to follow the flow of chemical industry into this rich and inviting territory.

WASHINGTON

BONNEVILLE and the utility folks in Portland very generously annexed much of Southern Washington in their new chemical and metallurgical domain. But one should not lose sight of the fact that Alco's $18,000,000 and Reynolds' $10,000,000 were spent at Vancouver, Wash., and Longview, Wash., respectively. The latter city has long been a thriving center for the pulp and paper industries—especially the large plants of Longview Fiber and Weyerhauser Timber (see *Chem. & Met.*, Aug. 1941, pp. 106-9). Plywood is another important industry of Southern Washington.

With Grand Coulee now coming into the power picture in a big way (see pp. 80 to 81), we may well expect to see many of the new defense industries develop in its immediate vicinity. In fact, an allotment of 100,000 kw. to be delivered over the federal transmission system to Spokane provides 65,000 kw. of Columbia River power for a 60,000,000 lb. aluminum reduction plant and 35,000 kw. for a 24,000,000 lb. magnesium plant. Presumably the latter plant will be operated by the Henry J. Kaiser interests, utilizing the magnesite and brucite deposits near Valley, Wash., to be reduced by either the Hansgirg process as at Permanente, Calif., or the Doerner process developed in pilot plant stage by the Bureau of Mines at the State College of Washington at Pullman, Wash.

Doerner's process differs from Hansgirg's principally in the use of a spray of cold oil instead of the large volumes of natural gas or hydrogen required for chilling the furnace gases of magnesium vapor, carbon monoxide, etc. This substitution avoids the cost of purifying the hydrogen (as in the original Hansgirg process), and is said to reduce the explosion hazard because it applies a protective coating of oil over the highly pyrophoric dust particles condensed from the furnace gases. In the pilot plant at Pullman the investigators claim to have obtained a conversion of about 75 percent of magnesia to metal with a power consumption of 7.8 kwh. per lb. of metal. Presumably this accounts only for the first reduction and one must add at least 3 kwh. for power used in the final distillation. A description of the State College of Washington process will be found in the report of A. E. Drucker and H. A. Doerner published by the Bureau of Mines in Information Circular No. 20, May 1940, and in other reports available at Pullman.

Some 32,500 kw. of Columbia River power has also been alloted for another 30,000,000 lb. aluminum plant at Tacoma which presumably will be operated by interests associated with Franklin W. Olin, president of the Western Cartridge Co. of East Alton, Ill.

Electrochemical and electro-metallurgical industries are not new to Tacoma. The Hooker Electrochemical Co. and the Pennsylvania Salt Mfg. Co. have long operated important plants there for the production of chlorine and electrolytic caustic soda. The byproduct hydrogen is used for synthetic muriatic acid and for hydrogenation of oils. Recently Penn Salt has become an important producer of sodium arsenite for use as weed killer. This Fall it will also have available sodium chlorate from its Portland plant which is similarly used. Ohio Ferro-Alloys is a new Penn Salt neighbor,

strategically located to contribute to the growing equipment industry of the Northwest.

Pat Hetherton, executive officer of the Washington State Planning Council in Olympia, has introduced an interesting innovation in the industrial programming in which he is engaged. He has set up a special committee of industrialists and scientific leaders who look over various inventions and suggested projects with a view to determining whether they shall be subjected to research and how they should be developed. An appropriation of $150,000 has made it possible to organize a careful and thorough-going analysis of raw materials and resources of this State. One excellent volume is already available.

Interesting but extremely "hush-hush" is the new plant in Seattle's outskirts of the Carlisle Lumber Co. Here production is getting under way on gas-mask carbon and "whetlerite" for which the Chemical Warfare Service announced a sizeable contract earlier this year.

NEVADA

MAGNESITE and brucite from Nevada figure prominently in several of the magnesium metal operations now getting under way in the Far West. By all odds, the largest of these is the three-plant project for which the Defense Plant Corporation has pledged $63,000,000 to cover cost of construction and operation of 112,000,000 lb. of capacity by Basic Refractories, Inc., of Cleveland, Ohio. This company has been an important producer and user of dolomite, magnesite and brucite with large holdings in the deposits north of Tonopah.

It is expected that the main plant will be located near Las Vegas since the primary source of its power will be Boulder Dam. The other plants will be at Mead and at Gabbs, Nevada, in the vicinity of the deposits of raw materials. It is reported that Basic Magnesium, Inc., will use the anhydrous magnesium chloride process employed by Magnesium Electron, Ltd. (see *Chem. & Met.*, Jan. 1941, pp. 78-81). This will require auxiliary chlorine and electrolytic cells will be installed in connection with one of the plants.

During the World War, Nevada was an important manganese producer and in recent months practically all of the older mines have been re-opened. Considerable interest attaches, therefore, to the $500,000 plant which the government is building at Bolder City to investigate the commercial possibilities in the Bureau of Mines electrolytic processes for recovery of metallic manganese from low-grade ores.

Nevada has long been supplying brucite for the basic furnace linings used in the steel industry. It is reported that as much as 200 tons a day have been shipped by Basic Ores, Inc., to its refractories plant near Cleveland, Ohio. Westvaco is said to be shipping 50 tons a day to its plant at Newark, Calif. Not as well known, however, is the fact that Nevada has been a steady shipper of gypsum for plaster and cement, as well as clays and other non-metallic minerals.

ARIZONA and NEW MEXICO

COPPER, gold and silver, lead and zinc—in that order of importance—are Arizona's chief contributions to metal production. Tungsten and molybdenum are associated with some of her copper ores while lead and zinc vanadates are developing as sources for vanadium. Chrysotile asbestos, according to Director Chapman of the Arizona Bureau of Mines, is proving a superior product for electrical insulation. Fluorspar, feldspar, bleaching clays, diatomite and other non-metallics, are of growing importance.

In New Mexico, the "big four" today are copper, zinc, lead and potash. According to President Needham of N. M. School of Mines, about a billion dollars of new wealth has been taken to date from the mines and quarries of that state. Writing in the 75th Anniversary issue of *Engineering & Mining Journal* (Aug. 1941, p. 141), he says: "I believe that in the field of non-metallics lies a bright future for New Mexico. We are handicapped by high freight rates and great distances from markets and many of our deposits are hard to reach. Yet populations and industries are slowly but surely moving westward and we, in New Mexico, are tired of paying freight eastward on raw materials and westward on the finished products. In time, industries, even though small at first, must move to New Mexico."

From the standpoint of chemical industry, the discovery and mining of potash in New Mexico is probably the outstanding achievement of the past two decades. Not only has it assured the American farmer of an adequate supply of an essential plant food, but it has given the chemical engineer a great opportunity for research and development. New methods of producing potassium derivatives may open important markets. Byproducts, such as magnesium chloride (see *Chem. & Met.*, Jan. 1941, p. 77), may prove the basis for a more diversified chemical industry. In the meantime, potash production is setting new records.

MONTANA

WHEN ONE thinks of Montana, it's of what President Thompson of the School of Mines has called "The city perched on 'the richest hill on earth,' from which copper continues to flow in an unending stream from a seemingly inexhaustible source." (*E.&M.J.*, Aug. 1941, p. 139). Every day 750,000 lb. of copper comes out from under the hill at Butte, and there is no reason to believe the stream will be halted in our lifetimes. That means that there will always be sulphur to recover from the "smoke," to make sulphuric acid, to make phosphoric acid and double and triple superphosphates. So there will always be a chemical industry here.

Vermiculite, of which President Thompson estimated that Montana has a reserve of at least 25,000,000 tons, is a product that has always interested us. You will recall how this mineral when it is heated, even with a match, expands to 8 or 10 times its original volume. That accounts for its growing use for heat, sound and electrical insulation. As the raw ore is mined, it weighs approximately 55 lb. per cu.ft.; after it has been exfoliated and dried, it weighs only about 6 or 8 pounds. Western Vermiculite Co. of Denver, obtains its ore from deposits near Libby, Mont., and ships it to its new processing plant in Denver.

IDAHO and WYOMING

George R. Mansfield, in 1940, (*Econ. Geol.* Vol. 45 No. 3, May 1940), estimated the phosphate reserves of the Western States as follows: Idaho, 5,736,335,000 tons; Utah (including grades down to 40 percent), 1,741,-480,000 tons; Montana, 391,323,000 tons, and Wyoming, 115,754,000 tons. In 1939 only the Idaho and Montana deposits were being worked to produce 95,451 and 44,384 long tons respectively. Anaconda Copper Mining Co.'s mine at Conda, Idaho, is the largest producing property. Mon-

tana's principal production comes from the Garrison mine which supplies the requirements of Consolidated Mining & Smelting Co., Ltd. of Trail, B. C.

Idaho's mining industry, in addition to its famous production of gold, silver and copper, has recently become of strategic importance because of the discovery, development and production of mercury (Almadin mine), the development of large tungsten ore bodies in the Patterson Creek area (Ima mine) and the extension and development of large antimony ore reserves at Stibnite (Bradley mine). (See *Eng. Min. J.*, Aug. 1941, p. 137.)

Wyoming has not yet proved its importance to the chemical process industries other than as a producer and refiner of petroleum (21,417,000 bbl. in 1939) and as a source of bentonite (76,133 tons in 1939) and of other mineral products, including coal (5,203,877 tons in 1938). However, the discovery in 1939 of a large deposite of trona (natural sodium carbonate-bicarbonate) in Sweetwater County, would seem to open up interesting possibilities for the establishment of a permanent chemical industry in this territory for the manufacture of sodium, potassium and phosphate compounds. (See *Chem. & Met.*, Feb. 1939, p. 86) and recent testimony of Robert D. Pike before Senate Subcommittee on Public Lands, p. 114 of this issue.

COLORADO

COLORADO'S chemical economy is already well advanced, exceeding both in size and diversity the chemical process industries of each of the 11 Western States except those along the Pacific Coast. The U. S. Census of 1939 lists 19 plants in the "chemical and allied industries" with output valued at $2,771,073, seven petroleum refineries turning out $6,407,038 of products, five insecticide and fungicide plants with $229,192 of output; six compressed gas plants producing $701,461 and 13 crude drug and medicinal establishments with production valued at $803,855. No production figures are published for Colorado's beet sugar industry, but it had 17 plants in 1937, compared with 13 for Michigan and 10 for California. The Census report did state, however, that "Colorado is the most important state in this industry" which must mean that the value of its production is in excess of $25,000,000.

The largest single ore body ever discovered in Colorado, according to C. W. Henderson of the Bureau of Mines (see *Eng. Min. J.*, Aug. 1941, p. 136), is the deposit of molybdenite of the Climax Molybdenum Co. Its production now exceeds in value each year the annual output of gold and, according to Mr. Henderson, this should continue for 50 to 100 years. Not so well known are Colorado's coal deposits which at present are estimated by Mr. Henderson to be sufficient to supply the current coal needs of the United States for at least 2,000 years.

UTAH

GREAT SALT LAKE is perhaps the greatest chemical resource of Utah. Its waters contain many times more magnesium chloride than is found in sea water. So far it has not been exploited for other than salt, but the national defense program is again focusing attention on this rich resource.

One of the factors that has retarded industrial development in the vicinity of the Lake has been the scarcity of fresh water for steam and process uses. To meet this problem face-on, the Industrial Development Commission of Utah proposes a bold solution. They would have the State undertake a project of placing dikes across a portion of the lake between an island and the mainland, and, after removing the water from this protected area, permit incoming river water to create a fresh-water lake. Given assurance of adequate water supply and with relatively cheap power from Utah coal, Chairman A. S. Brown is convinced that industries will be attracted by the possibilities in recovering magnesium compounds and other chemicals from Great Salt Lake.

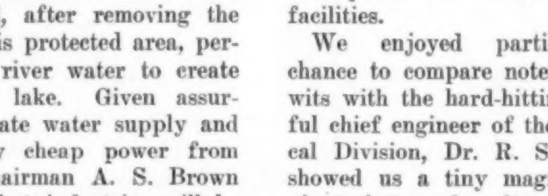
Bonneville Flats, made internationally famous for its 330-m.p.h. auto racers, is setting some new records these days. We were told in Salt Lake City that it is daily producing three or four carloads of potash for shipment to eastern fertilizer markets.

On August 26, 1941, the OPM recommended to the War Department that the extraction of alumina from alunite should be started on a small scale at Marysvale, Utah. This operation would be carried on by Kalunite, Inc., of Salt Lake City, with a plant having a capacity of 100 tons of ore per day. In addition to treating alunite, the plant would engage in the experimental treatment of various aluminous clays, which exist in far greater quantities than any other aluminous materials in this country. The production of alumina from alunite or clays has never been accomplished on a commercial scale, although pilot plant operations handling about a ton of ore per day have been conducted by Kalunite, Inc., for some time.

Thorough-going research on the metals and minerals of the Inter-Mountain area centers in the splendidly equipped metallurgical experiment station of the U. S. Bureau of Mines at Salt Lake City. On a hill in the center of a four-acre site adjoining the University of Utah are a series of connected buildings that house complete facilities for chemical, physical and metallurgical investigations. *Chem. & Met.* readers interested in laboratory construction and operation will do well to secure a copy of Circular 7116 from the U. S. Bureau of Mines in Washington which contains a detailed description of these remarkable facilities.

We enjoyed particularly the chance to compare notes and match wits with the hard-hitting, resourceful chief engineer of the Metallurgical Division, Dr. R. S. Dean. He showed us a tiny magnesium pilot plant that used molten lead to dissolve and recover magnesium metal distilled from an oxide reducing furnace. He isn't ready yet to make any claims for its commercial practicability, but he has some samples of metal to show that the process works and that the final distillation and purification of the magnesium distilled from the lead-magnesium alloy isn't going to give very serious trouble from a technical standpoint.

Reprints of this 16-page report are available at 25 cents per copy. Address the Editorial Department, *Chem. & Met.* 330 W. 42nd St., New York, N. Y.



MAGNESIUM by the Hansgirg Process

SIDNEY D. KIRKPATRICK *Editor, Chemical & Metallurgical Engineering*

Chem. & Met. INTERPRETATION

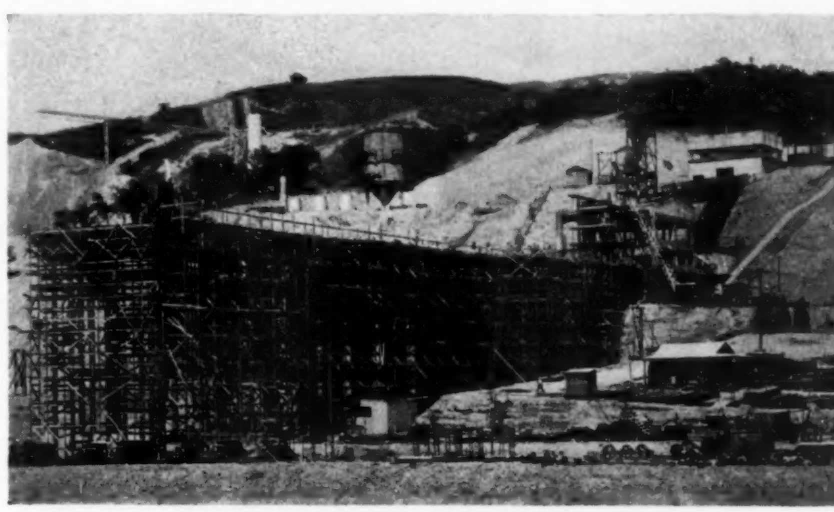
This country's first commercial plant for the production of metallic magnesium by the electrothermic reduction of the oxide is just beginning to operate in California. Much depends on the success of this operation.* If results comparable to those obtained by Dr. Hansgirg in foreign plants can be duplicated here, the Kaiser interests will sponsor a tremendous expansion program, both at Permanente and in the Pacific Northwest. Hence unusual interest attaches to this first-hand report of our editor who visited the plant in mid-July. Most of the photographs were made especially for *Chem. & Met.* at the time of and following our visit.— *Editors.*

HIGH UP on a hillside, overlooking the fertile Santa Clara Valley of California, about 45 miles south of San Francisco and 12 miles directly west of San José, are two of America's most interesting plants. One produces lime and cement in the world's largest kilns and because of unique engineering and construction features, its costs are said to be lower than those of any other existing cement plant in the United States. Directly alongside is an equally revolutionary venture of the Chemical Engineering Division of the Todd-California Shipbuilding Corporation—this country's first commercial plant for the production of metallic magnesium by the electrothermic reduction of the oxide.

Behind both of these projects is the vision, energy and resourcefulness of the man who is widely known as "America's No. 1 Builder." Henry J. Kaiser, president of the Permanente Corporation, was one of the founders of Six Companies which built Boulder Dam and he has since been identified with many other huge construction and shipbuilding projects of the West. Associated with him as General Manager of both the Permanente cement and magnesium projects is Harry P. Davis, who also has something more than a local reputation for getting results in plant construction and operations as well.

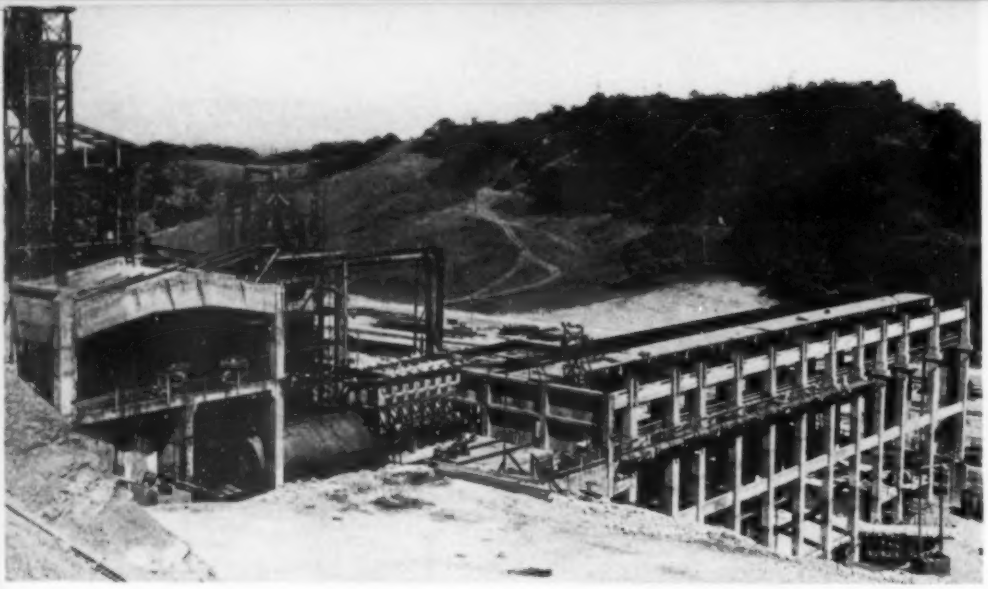
Our chief interest in visiting Permanente on July 18 was to renew acquaintances with Dr. Fritz J. Hansgirg, the eminent chemist, who developed the electrothermic reduction process that bears his name and which is to be used at Permanente. He had begun his early work at Radenthein, Austria, in 1929 and after successfully operating a pilot plant there, commercial plants were built at Konan in Korea and at Swansea in Wales.

Although Dr. Hansgirg had personally directed the design and construction of the Korean plant, he had not been permitted to bring his drawings and technical data to this coun-

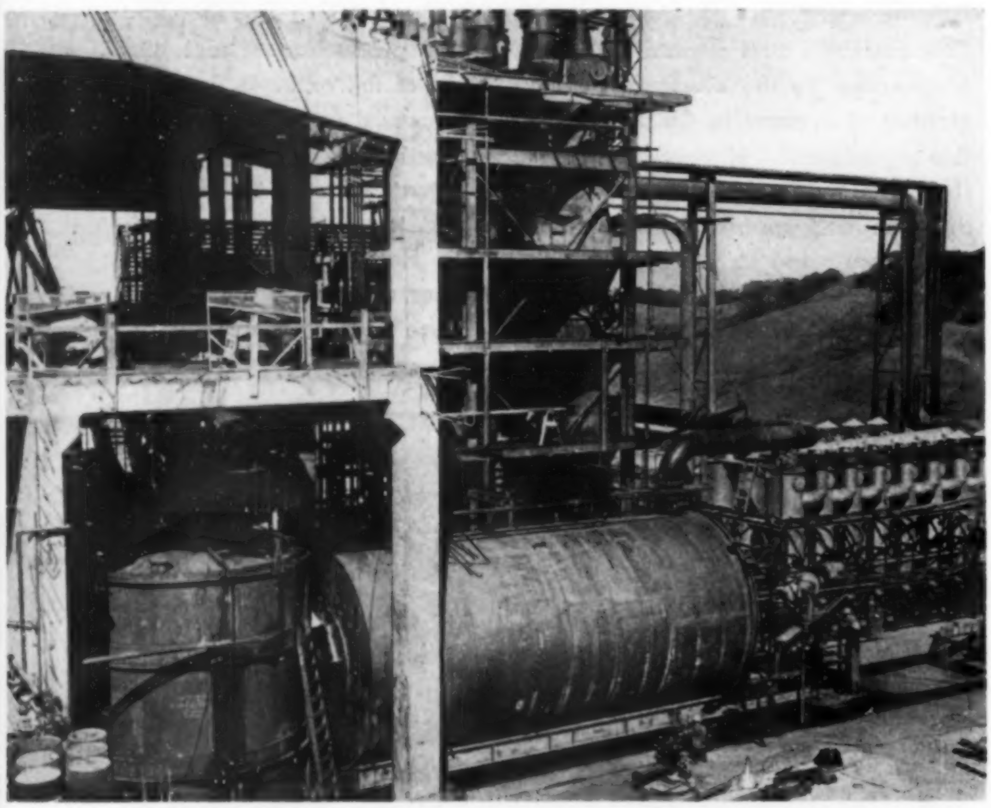


Kaiser's Permanente magnesium plant as of July 15, 1941

* Word comes from California of an unfortunate accident and some slight damage to the Permanente plant during initial operations on August 28. Three men were killed and two others burned while working on experimental equipment for loading magnesium dust into the retort for final distillation. Chemical engineers familiar with the process as used abroad and with Henry Kaiser's ability to get results are still confident that the Hansgirg process will be made to work as described in this article. S. D. K.



This side view shows multi-level construction looking into the main furnace building and over the roof of the retort house



Reduction furnace with chilling cone, condenser cooler, electric agglomerators and bag filters

try so that, in a sense, the Permanente project had to start from scratch. The amazing progress which has been made in less than six months is evidence that he carried with him sufficient of the "know-how" to guide Kaiser's engineers to a remarkable achievement in plant construction. Some time this month (August), the first unit is scheduled to go into operation and if the initial plant works as successfully as expected by its designer and builders, it is to be the forerunner of a tremendous expansion program that will ultimately be producing at least 24,000,000 lb. (and perhaps even 40,000,000 lb. or 48,000,000 lb.) of magnesium per year.

The Permanente project started in February 1941, when the Reconstruction Finance Corporation approved a loan of $9,250,000 for the construction of magnesium production and fabricating facilities, which will have a total cost of about $11,500,000. With the advance of $3,500,000 in March 1941, construction started on the first 8,000,000-lb. unit, and has proceeded on a 24-hour basis, 7 days a week. With the completion of the first unit, work is to start on the second to be completed by November, and the third by February 1942. Two or three other units are planned which would round out the annual production to 40,000,000 or 48,000,000 lb.

The new plant was built on the hill or mountainside to secure good foundation for the buildings and to take full advantage of gravity flow of materials, which is also an important part of the strategy of the neighboring cement mill. This location likewise permitted an economical use for the natural gas which, after it has served as the cooling medium in the magnesium process, is used as fuel in the cement mill. The plant site was prepared by excavating and levelling off a series of ledges or shelves on which the separate units of the plant were built.

On the very crest of the hill is the water and storage reservoir and the huge redwood cooling tower, the oil storage reservoir, and the large gasholder for the natural gas. On the next level are the storage bins for the raw materials, magnesite, carbon,

Raw material preparation plant and production and storage facilities for nitrogen and hydrogen

and tar; and the grinding, mixing, and briquetting plant for these raw materials; also the hydrogen and nitrogen plants. The main reduction furnace house is on the next level as are also the condensers, electric agglomerators, cooling chambers, and dust collecting equipment. Finally, on the fourth, or lowest, level are the retorts for the distillation, and the furnace and foundry for melting and fabricating the finished product.

General features of plant construction can perhaps best be discussed in connection with a brief outline of the original Hansgirg process and some of the modifications that are being made in the Permanente installation. It depends, basically, on the reduction of magnesium oxide to magnesium, using finely divided carbon as the reducing agent. The reduction is effected in an electric resistance furnace at a temperature of approximately 2,000-2,100 deg. C. Under these conditions, the reaction proceeds according to the equation: $MgO + C = Mg + CO$ but unless the products of the reaction are suddenly cooled, the equation quickly reverses itself and little or no metallic magnesium is produced.

COOLING WITH NATURAL GAS

In the original Hansgirg process this rapid chilling was obtained by the use of large quantities of hydrogen. At Permanente, natural gas is available for the cooling medium and since it can be readily utilized as fuel by the adjoining cement mill, there is no necessity for the elaborate equipment used in the foreign plants to purify the hydrogen for reuse by removing with ammoniacal copper solution the carbon monoxide that it picks up from the furnace gases. In the California plant, the magnesia (obtained either from calcining magnesite or brucite from Nevada or directly from the nearby plant of Westvaco Chlorine Products Corp.) is mixed with petroleum coke and formed into briquettes, using pitch as the binder. The briquettes are then fed continuously into the reduction furnace—a totally inclosed, carbon-brick lined, 3-phase electric arc furnace. An atmosphere of hydrogen is maintained in the furnace to prevent the entrance of magnesium powder to the isolated electrode glands. The first furnace to be used at Permanente is of 8,000 kva. capacity but larger ones of 12,000 kva. are being contemplated.

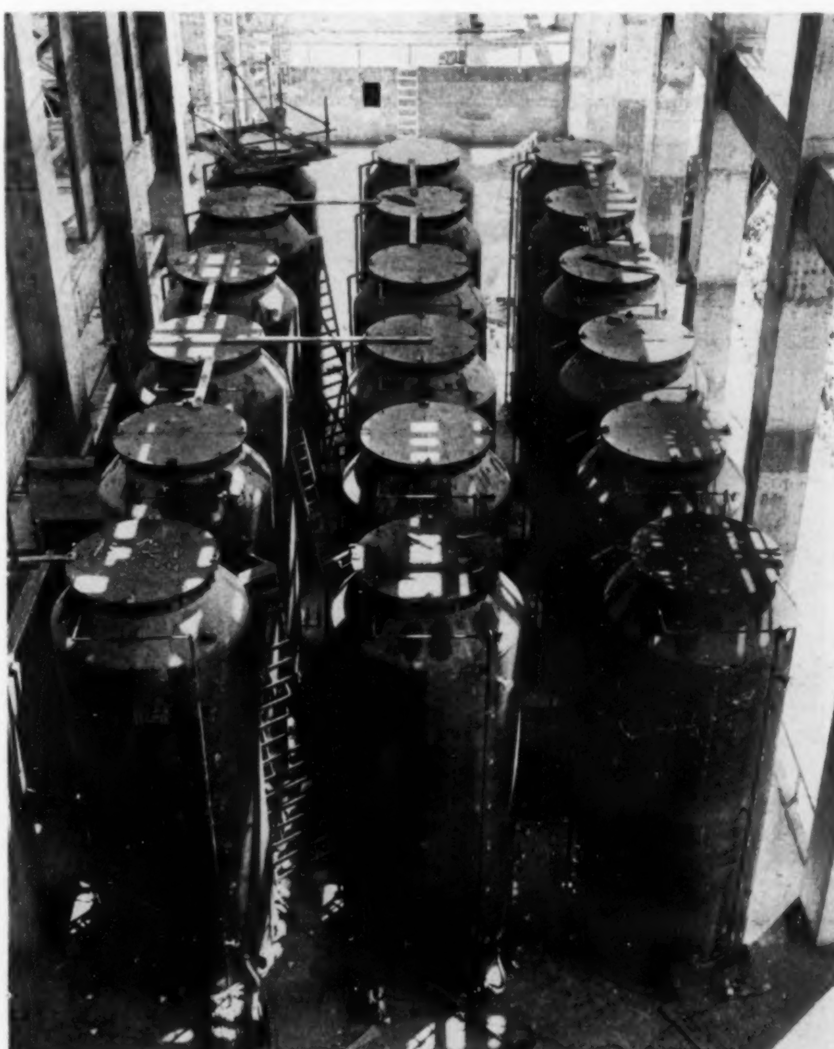
The reaction products from the furnace are drawn off at one side through a specially designed stainless steel nozzle and condenser. They are immediately chilled by the blast of natural gas, ingeniously injected through the condenser at the rate of approximately 25 volumes of natural gas to each volume of furnace gases. After this initial quenching the magnesium, along with certain impurities, is carried as fine dust into the cooling chamber—a large cylindrical drum equipment with revolving scrapers to prevent caking on the side walls and with a reaming mechanism to prevent any plugging of the furnace nozzle. As the velocity is reduced, some of the magnesium powder drops to the bottom of the condenser and is caught by a screw conveyor that takes it to a dust storage bin.

In the meantime the temperature of the gas has been lowered to about 150 to 200 deg. C. and most of the dust is carried by the cooling gases to an electric "agglomerator." This is an electrostatic precipitator that serves to increase the particle size of the magnesium dust. The balance of the dust is removed in woolen bag filters and that portion of the gas which is not recirculated (approximately 25 percent) is withdrawn for fuel use in the cement mill.

REDISTILLING THE MG DUST

The dust from this primary reduction consists of 60 to 65 percent of metallic magnesium, contaminated with some MgO and carbon carried over from the furnace. Before it can be purified by redistillation it is compressed without a binder into the form of tablets in a specially designed tableting machine. These tablets are then charged into totally inclosed, electrically heated retorts that operate at temperatures

Retort furnaces as they appeared on July 12, 1941. Eighteen more are to be installed in September to bring this unit's production up to about 12 tons a day



of about 750 deg. C. and under extremely high vacuum. These retorts, which are operated on a batch basis, will each hold sufficient tablets to yield slightly more than a ton of metallic magnesium every 72 hours. At the time of the writer's visit in July, 18 retorts had been put into place and 18 more were to be installed in September, which would indicate a contemplated output at that time of at least 12 tons per day for the first unit.

The vaporized metal rises to the upper part of the retort and is deposited there on the water- and oil-cooled steel walls of a removable shell. After the distillation is completed, the top of the retort furnace is removed and an overhead crane lifts out the upper shell on which the metallic magnesium has condensed into a crystal ring shaped like a huge doughnut. This is dumped on the ground floor of the adjoining cooling room and transported from there to the conventional foundry furnaces for remelting and casting into the form of pigs or ingots. The metal in this form is understood to have a purity of about 99.97 percent.

An important part of the Hansgirg process is the provision of accessory equipment and facilities. For example, a cooling oil system is required to remove excess heat from the reduction furnace's electrode glands and from other equipment such as the electrostatic agglomerator. Nitrogen, produced by burning the oxygen out of air with natural gas, is used for purging apparatus during shutdown periods. The hydrogen used in the reduction furnace and elsewhere in the process is currently produced at Permanente by the electrolysis of water but may ultimately be made by cracking natural gas. A continuous circulation of cooling water is required in the jacket around the first cooling chamber and later around the top sections of the final retorts. A flushing oil system is provided to spray oil on pyrophoric dust whenever certain equipment is opened for inspection or repair.

According to information published by Dr. W. S. Landis in 1937, after visiting the Austro-American Magnesite Company in Radenthein, Austria, (see *Trans. Electrochem. Soc.* **72**, 293-316, 1937), the estimated power consumption for the Hansgirg process per pound of magnesium is approximately as follows:

Reduction furnace	6.6 kwh.
Distillation	1.1 kwh.
Remelting	0.2 kwh.
Auxiliaries	0.2 kwh.
Total	8.1 kwh.

However, he points out that an additional 1.8 kwh. per lb. would be required for maintenance of the hydrogen supply, but in case that natural gas is used, as at Permanente, this could probably be reduced to at least 1.4 kwh. making the total power requirement 9.5 kwh. per lb. or about 19,000 kwh. per short ton of magnesium. This figure, as Dr. Landis points out, is substantially lower than the power requirement in aluminum production.

A CITY IN ITSELF

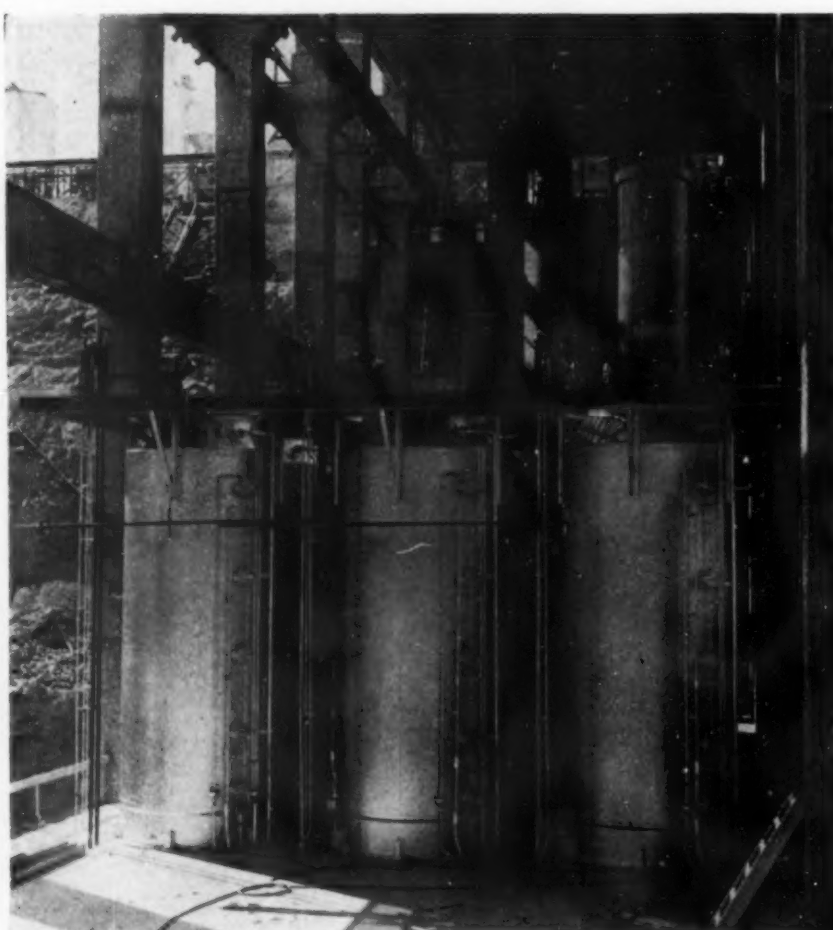
When the Permanente plant is completed and running to full capacity, the Pacific Gas & Electric Co. has estimated that the electric demand will approximate 100,000 hp.—or more than a third of the total required by the entire city and county of San Francisco.

Adjoining the plant is an attractive new office building and alongside of it there will be shortly completed a windowless, completely air-conditioned chemical laboratory.

The tracks of the Southern Pacific Railroad, on the line between Palo Alto and Santa Cruz, come within 2½ miles of the plant site. A branch had been built by the cement company and connects both plants with the main Southern Pacific tracks at Simla Station. Permanente Creek, which runs through the property and from which the plants take their name, is available for cooling water although the principal supply is purchased from one of the utilities in the valley and is pumped to the reservoir at the crest of the hill. A pond formed by damming a canyon near the cement plant gives additional water storage and provides most of the water used in the crushing and grinding operations.

For the privilege of visiting this interesting plant and for the photographs and the data that accompany this brief article, the writer is indebted to Harry P. Davis, general manager of the Permanente plant and to Dr. F. J. Hansgirg of the Chemical Engineering Division of Todd-California Shipbuilding Corp.

Side view of retorts and furnaces as they appeared on August 23, 1941



Magnesium Situation As We See It Today

A *Chem. & Met.* Interpretation

MAGNESIUM is required for Uncle Sam in unprecedented quantities. It is needed both for the manufacture of very light metal parts, especially in aircraft, and for use as an incendiary material in projectiles. In June, 1941, OPM's official estimates of requirements were 400,000,000 lb. per year of metal-producing capacity. All this was wanted in 1942. The facts given below, however, indicate that actual output will probably fall far below this desired total.

Until August, 1941, there had been no commercial production of magnesium in the United States except by Dow Chemical Co. in its plants at Midland, Mich., and Freeport, Tex. A number of other companies have made a few hundred pounds or have operated very small pilot plants. The first commercial operations, other than Dow's, are just now getting under way at the Permanente Corp. in California as noted on the preceding pages. Several other companies are, however, beginning or about to begin construction of works to make this light metal at plants which are being financed by the Defense Plant Corp., a subsidiary of R.F.C.

It is not likely that the aggregate capacity now being negotiated by the government can reach the desired 400,000,000 lb. until 1942 mid-year or perhaps several months later. At the end of August the situation was approximately as follows:

Desired Magnesium Metal Capacity

(In millions of lb. per year)

	Now Authorized	After Possible Expanion
Dow Chemical Co.	54	126
Permanente Corp.	24	48
Basic Magnesium, Inc.	112	112
International Agric. Corp.	none	90
Mathieson Alkali Works	none	
Diamond Alkali Co.	none	
	190	376

Dow Chemical Co. originally built both Midland and Freeport works with its own funds. Some of the more recent extensions have been financed, at least in part, with R.F.C. capital. The bulk of Dow's production is, however, from works that will remain permanently within its control regardless of post-emergency settlements with the government. All of the other commercial plants now authorized or under negotiation are being built almost wholly with government capital for the fixed investment in structures and equipment. In most cases the companies contracting to design, erect, and operate the works have the right of retaining ownership by making some suitable post-emergency settlement with the government. And during the emergency these contracting companies are furnishing all of the funds necessary for working capital and, in some cases, a certain part of the fixed capital.

Other than Dow and Permanente, the third major contractor has been Basic Magnesium, Inc., a subsidiary of Basic Refractories Corp. of Cleveland. The plant or plants which it will build in Nevada will, according to initial proposals, be the largest in the world, with 112,000,000 lb. per year of metal capacity. Associated with the American staff of this firm are a number of experienced British chemical engineers who have worked on magnesium manufacture. To a considerable extent the Nevada project will, therefore, be based on successful English manufacturing methods and will use the English type of electrolytic equipment (see *Chem. & Met.*, Jan. 1941, pp. 78-81).

Throughout the summer there have been frequent negotiations between several electrochemical companies and the R.F.C. staff in an effort to formulate a satisfactory contractual basis. The three companies mentioned in our tabulation, and others who have dropped out of the negotiations, have planned to use the American type of electrochemical processes, in most cases closely following the Dow technique as used at Freeport. This company is, at the request of the government, making its experience available to the engineers and operators of these other plants.

The projected plant of International Agricultural Corp., or rather of its subsidiary, Union Potash & Chemical Co., will be supplied with magnesium chloride obtained from the brines of its Carlsbad, N. M., potash refinery. (See *Chem. & Met.*, June, 1941, pp. 78-81.) This $MgCl_2$ brine is to be concentrated to a shippable density or to dryness for use as the raw material for an electrochemical plant, probably in Texas. Final decision has not been reached by other companies as to the extent to which natural brines or magnesium minerals will be employed in their manufacture.

In view of the aerial warfare which is developing so rapidly abroad, there seems to be almost no limit to the quantity of magnesium which may be used for incendiary bombs. It is well appreciated, therefore, that successful prosecution of all present plans in magnesium manufacture does not by any means represent the ultimate potential requirement. Certainly there will be discussions of many other plants and processes. At least one in the Pacific Northwest seems almost certain. (See Fig. 1 page 77.) By the end of 1942 it may well be that the U. S. output will be at a rate greater than the world output in any year prior to 1941.

Actual Consumption [1] of Primary and Secondary Magnesium in 1940, by Uses *

Use	Lb.	Use	Lb.
Structural products [2]	7,363,200	Scavenger and deoxidizer	361,600
Aluminum alloys	3,556,500	Pyrotechnics	43,500
Zinc alloys	68,000	Chemicals	70,200
Other alloys	17,600	Other	50,400
		Total	11,531,000

* From "Our Magnesium Resources," by H. A. Franke, *Mining Congress Journal*, Aug. 1941, p. 17.

[1] In addition to the 11,154,868 lb. of primary magnesium delivered by the producer to domestic industry in 1940, consumers withdrew metal from stock and purchased and consumed old and new scrap totaling 376,132 lb.

[2] Castings, sheet, extruded shapes, forgings, etc.

This solar evaporation pond, covering 100 acres, is used by the Desert Chemical Co. to remove salt from residue brines

Chemicals from California's Desert

PAUL D. V. MANNING *Pacific Coast Editor, Chemical & Metallurgical Engineering*

Chem. & Met. INTERPRETATION

From California deserts to soap and glass and rayon may seem a long stretch to most chemical engineers, although these deserts have long been known to be rich in saline deposits. Only within recent years have the deserts of this country been exploited for chemicals other than those few, such as borax, seldom found elsewhere. California, having more than its share of the desert land, naturally has a large proportion of these plants.—*Editors.*

Oldest and one of the best known of California's desert chemical operators is the Trona plant of the American Potash & Chemical Corp. at Searles Lake. Ever since the publication of Teeple's classic monograph on the Searles Lake development, most chemical engineers have been familiar with this company's remarkable application of phase rule chemistry to the development of an independent American potash industry. More recently the West End Chemical Co., also operating at Searles Lake, and the Pacific Alkali Co. at Owens Lake, have recovered chemicals from California's desert brines. And only this year the Desert Chemical Co. began operations at Dale Lake to recover sodium sulphate and sodium chloride by a process of fractional crystallization. In addition to these concerns, about which this article is primarily concerned, the Natural Soda Products Co. has been producing trona at Keeler on Owens Lake and the Pacific Coast Borax Co. carries on well-known mining operations at Mohave and at Death Valley Junction.

Searles Lake in California has long been famous for the operations which produce potash and borax from the brine wells sunk from its usually dry surface. Operators on Searles Lake have drilled wells in the crystal bed, deep enough to avoid contamination from surface water and to insure a constant brine temperature. Thus the supply of raw material is quite constant in composition. Not so well known, however, are the methods of extraction used at Dale Lake and Owens Lake. The former is actually a subterranean brine deposit. At the latter, brine for the operations is pumped from wells sunk in the crystal bed.

SODA ASH FROM SEARLES LAKE

Two organizations working on Searles Lake, American Potash & Chemical Corp. and the West End Chemical Co., make a number of chemicals. The former company manufactures borax, potash, soda ash, sodium sulphate, boric acid and bromine, while the West End Chemical Co. manufactures lime, soda ash and borax. While the American Potash & Chemical Corp. uses processes of crystallization in the production of all but boric acid and bromine, the West End Chemical Co. uses an interesting process of carbonation for separating borax and sodium carbonate. Lime is obtained as a byproduct in the production of carbon dioxide gas for the carbonating process. The limestone is trucked to the plant from the quarry about 17 miles away where it is burned with coke, the gases passing to the carbonating towers along with gas recovered from the bicarbonate calciners.

Separating sodium carbonate from brine by the West End process differs considerably from similar operations on Owens Lake because it makes possible the production of borax directly as the tetraborate. This process is disclosed in U. S. patents 1,733,537 and 1,756,122.

Brine from the wells is carbonated in tall towers with gas from the lime and calcining kilns. The gas is first scrubbed and compressed. Carbonation to a controlled and constant pH precipitates sodium bicarbonate, which is first clarified by thickeners and then filtered. The filtered, carbonated brine is mixed with about the same volume of untreated lake brine, thereby converting the more acid borates to tetraborate with which the solution is now supersaturated. Spraying this solution in open air cooling ponds causes the borate to crystallize. It is separated from the mother liquor, first by means of Dorr thickeners, next by filters. The cake

is used to produce both anhydrous and refined, crystallized decahydrate borax.

Sodium bicarbonate produced by the carbonation is filtered, carefully washed and then calcined in standard rotary calcining kilns. Dense ash is made as in the ammonia-soda industry.

Handling of a dry, heavy powder, such as soda ash, in a manner to prevent dust from being lost and deposited over equipment involves certain problems. Certain types of conveyors easily jam and others require constant attention. In the plant of the West End Chemical Co., this problem has been solved by the use of 5-in. Redler conveyors with alloy steel chains. This conveyor consists of a tightly closed steel housing, rectangular in cross-section and only slightly wider than the chain link. The conveying chamber is at the bottom of the rectangular cross-section. The chain link is U-shaped with a "backbone" connecting the lower part of each *U*. The hinge point is also at the base of each *U*. The chains suggest to some extent the skeletal vertebrae of a large animal.

In operation, the chain rides on the powder being conveyed and not on the floor of the housing. The chain acts as a reinforcing element for the column of material in conveying in a vertical direction. The return of the chain is in the same housing with *U* links riding with the flat part of the ends resting on supporting members on the sides of the housing.

At the West End plant the hot calcined soda ash is discharged from the furnace into a Redler conveyor. This carries the ash up to a discharge over the storage bin. The bottom of the conveyor just ahead of this discharge is made of perforated metal, and this allows all fine materials to sift through to the bin, while coarse tailings are carried to the discharge. Redler conveyors are also used in further handling of the ash for packing and loading.

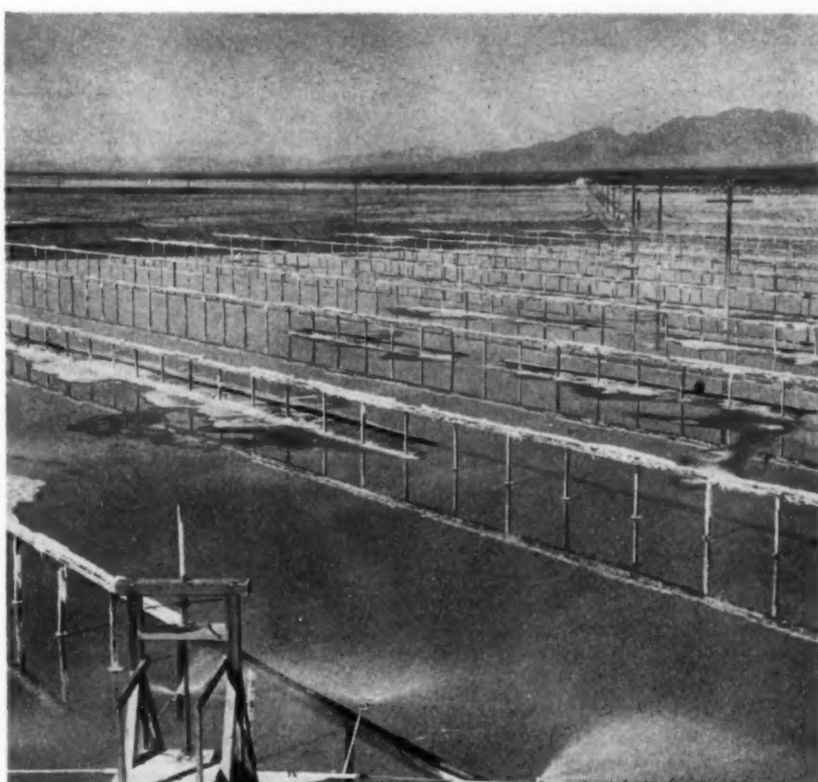
SALT AND SODIUM SULPHATE

Production of sodium sulphate and sodium chloride by a process of fractional crystallization was begun this year on a commercial basis at the plant of the Desert Chemical Co., Dale Lake, Calif. Shipments of glauber salt have been made and completion of the first year's cycle is expected to produce approximately 50,000 tons of sodium sulphate.

The first production unit, for which ground was broken in March 1940, placed in operation a process that had been demonstrated by pilot plants of increasing size over a six-year period. This process is made possible through a unique combination of brine content, climatic conditions and available fresh water at low cost. The process depends entirely on the effect of natural changes in temperature throughout the year.

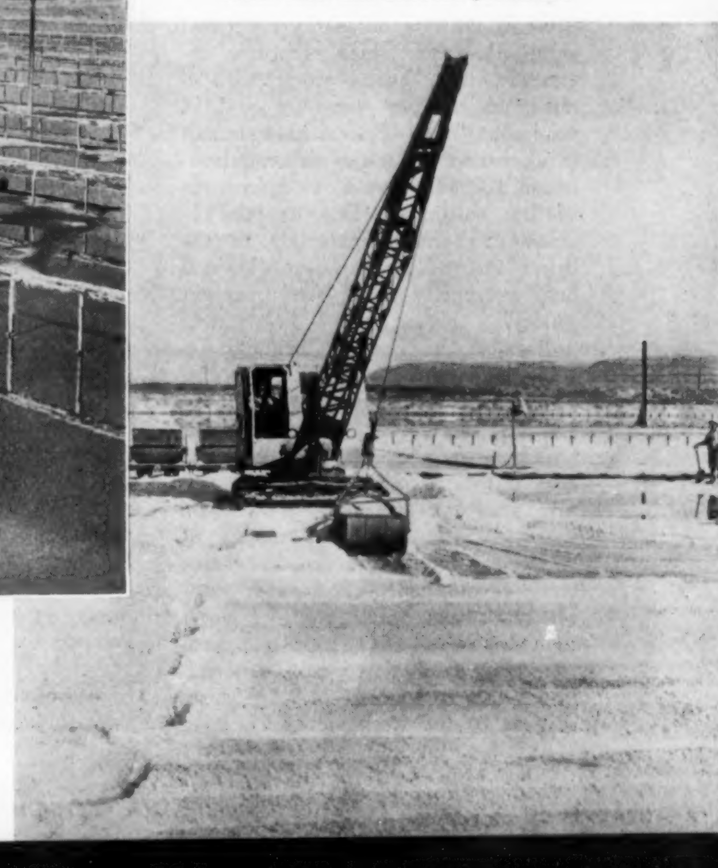
Under the desert floor in this little valley, about 200 miles east of Los Angeles, is a subterranean brine lake. Test wells on each 10 acres of an initial 520-acre tract showed deposits of approximately 12,000,000 tons of sodium sulphate. The estimated deposit under the entire 1,500-acre property, as shown by less frequent test-wells, is between thirty and thirty-five million tons. The lake level has been constant for many years, and apparently unlimited fresh water is available four miles from the lake boundary.

The brine contains 22.5 percent sodium chloride and 7.5 percent sod-



In this wood-lined finishing tank, 7.5 acres by 3.5 feet, the Desert Chemical Co. obtains 99.5 percent purity anhydrous sodium sulphate by solar melting and dehydration of glauber salt above a temperature of about 90 deg. F.

Harvesting salt for commercial purposes with a Bay City dragline in the fields of the Irvine Company, Tustin, Calif. This dragline, equipped with a special one-yard bucket, can load 300 dump cars in eight hours and thus lower costs and increase production



ium sulphate, with traces of other compounds. This combination of two salts can be fractionally crystallized by variation in temperatures. For three or four months each year, day temperatures range from 100-140 deg. F.; during the winter months, night temperatures are always below 50 deg. F., and wet bulb depressions average 15-16 deg. Weather Bureau records indicate that the time loss from the natural cycle will not exceed a total of one month in ten or twelve years.

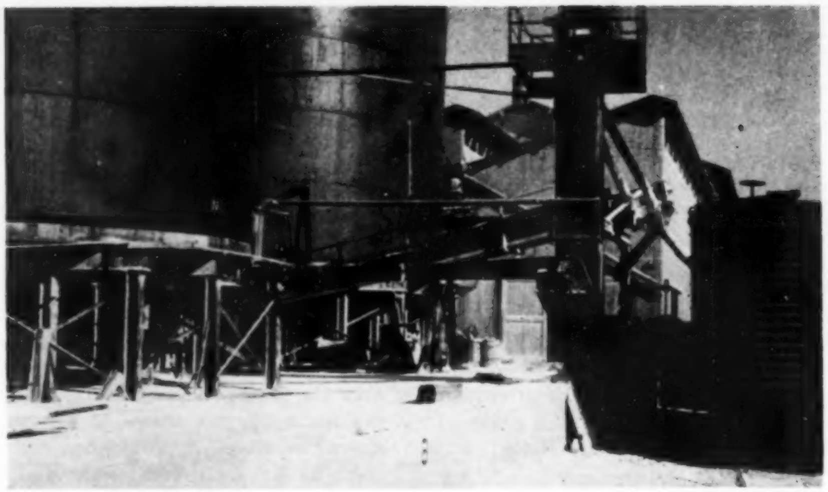
GLAUBER SALT PRODUCTION

The production cycle starts by primary separation of glauber salt in cold weather. The brine is pumped from the wells to a separate pumping station, from which it is sprayed into four separate tanks in rotation. At temperatures under 60 deg. F., glauber salt starts to deposit. The period of time required for this deposit is determined by the temperature.

Residual brine, containing some sodium sulphate, is pumped into an evaporation pond which covers 100 acres. During the summer, brine is added only as fast as evaporated in order to give a constant production of sodium chloride. This salt is then given the usual series of washings for purification to a marketable state.

Glauber salt remaining in the primary settling tanks is redissolved in fresh water and dehydrated by solar melting in wood-lined finishing tanks. This natural dehydration is accomplished only by obtaining saturated solutions, from which complete extraction may be obtained with a minimum surface exposure and in minimum time. Excess glauber salt is deposited from the saturated solution above 90 deg. F. as anhydrous sodium sulphate. Due to the absence of foreign materials in the brine, the sodium sulphate obtained has averaged about 99.5 percent purity.

Because the Desert Chemical Co. process depends only on the exposure of salt solution to climatic influence, there is no necessity for boilers, condensers, mechanical evaporators or other equipment usually used for salt recovery. There was, however, a large amount of work required before the first brine could be pumped. The four primary settling tanks each cover 7.5 acres to a depth of 4.5 ft.; the evaporation pond is 100 acres, and the wood-lined finishing tanks are 7.5 acres in area by 3.5 ft. in depth.



A 5-inch Redler conveyor feeding soda ash from storage bins to the box car loader at the plant of the West End Chemical Co.

Building these vats involved dirt moving for about five miles of embankment, averaging 166 cu.ft. per square foot of cross-section. The adobe earth promptly bakes to a surface that requires no paving or siding except in the finishing tanks. Construction also includes 12 miles of road, a complete diesel generating plant, six miles of power line and quarters for the company officials and employees.

Each well has a pump operated by a 40-hp. motor and discharges 900 gal. per min. into 18-in. concrete pipes. These lines are gathered at the central control station which is equipped with two pumps operated by 40-hp. and 15-hp. motors, respectively. The brine moves to the settling tanks through 24-in. lines to 8-in. headers with spray nozzles at every 25 ft. All pipes have composition liners to retard corrosion. The lines to the evaporation pond are 18 in.

Dale Lake was discovered in 1920 by Irvin Bush, chemist for the Capital Supply Mine, then owned by Charles M. Schwab. His preliminary tests were backed by Lyman Stewart, president of the Union Oil Co. The death of Mr. Stewart stopped production plans, which were then suspended for nearly 20 years. During that period tests were made on an increasing scale, both to determine the salt deposit and to prove the process. In March, 1940, Desert Chemical Co. leased 1,500 acres for 99 years, with a purchase option, and immediately opened construction on the present production unit. This company is one of a group of firms associated with the George Pepperdine Foundation.

In this desert country of California is another source of the same chemicals produced at Searles Lakes. This is Owens Lake in Inyo County. While Searles Lake is normally dry, Owens Lake is an alkaline water lake into which flows the Owens River when the city of Los Angeles does not want the water for supplying its first aqueduct. This variation in input causes a fluctuation in percentage of the various solids in the brine, and with the exception of one plant, operations at Owens Lake have not been highly successful. The lake brines contain common salt, soda, borax and other soluble salts.

OPERATIONS AT OWENS LAKE

The Pacific Alkali Co. has a plant on the west shore of Owens Lake at Bartlett, about 10 miles south of Lone Pine. According to one report (*Mineral Trade Notes*, U. S. Bureau of Mines, Sept. 1939), operations at this plant are as follows:

Brine is pumped through 2.5 miles of 14-in. pipe into three vats which range from 15-50 acres in area. After being concentrated by slow evaporation to 12-14 percent soda, the brine is run to storage reservoirs and then is pumped into 16 carbonating tanks each 6 ft. in diameter and 80 ft. in height. Carbon dioxide gas made from dolomite is forced into these tanks, thereby precipitating sodium carbonate, which is drawn off from the bottom as a sludge, centrifuged, and then dried and screened for laundry use or calcined in Herreschoff furnaces into soda ash, which is screened and sacked for shipment. After the soda is removed, the mother liquor is chilled to precipitate borax, passed through an Oliver filter and returned to the lake. The crude borax cake is redissolved and the solution is treated chemically, clarified in Sweetland filters, and chilled again. The purified borax crystals are recovered

in a centrifugal dryer, and this liquor likewise goes back to the lake. This plant can produce about 1,000 tons of soda and 2,000 tons of borax per season, according to the report.

POTASH OPERATIONS AT TRONA

The Trona plant of the American Potash & Chemical Corp., started in 1916, has made remarkable achievements in phase rule engineering. Even during the past two years this concern has achieved further successes in reducing the complexities of phase rule chemistry to engineering practice and the production of chemicals, particularly to the production of potassium sulphate and recently to bromine and lithium salts. The total number of products are now eleven, all made from a complex brine which serves as a single raw material. These products are: fertilizer grade potassium chloride of about 98 percent purity, and a grade further refined for the chemical trade, potassium sulphate, sodium sulphate, sodium carbonate, sodium chloride, sodium borate decahydrate, sodium metaborate, boric acid, bromine and lithium salts. Sodium chloride is the only product that is not marketed.

With the declaration of war in 1939, European sources of potassium sulphate were abruptly terminated, leaving the United States with wholly inadequate supplies. It was to meet this situation that the American Potash & Chemical Corp. entered upon its present scale of production. Potassium sulphate is now produced by a phase rule process once regarded as impossible. This involves the double decomposition of potassium chloride and sodium sulphate to produce potassium sulphate. Those familiar with this system will recall that glazerite, the double sodium potassium sulphate, tends to crystallize over the entire diagram until the sulphate or chloride ion is exhausted. Separation of these, however, is now being achieved on a large commercial scale.

Production of bromine and lithium salts which occur in Searles Lake brine in traces is a further achievement made possible only through years of painstaking work by a corps of chemists and chemical engineers skilled in phase rule chemistry.

Although certain operations of the American Potash & Chemical Corp. at Searles Lake have been previously described (*Chem. & Met.* Nov. 1931, p. 644 and Sept. 1938, pp. 491-2), these operations will again be reviewed briefly.

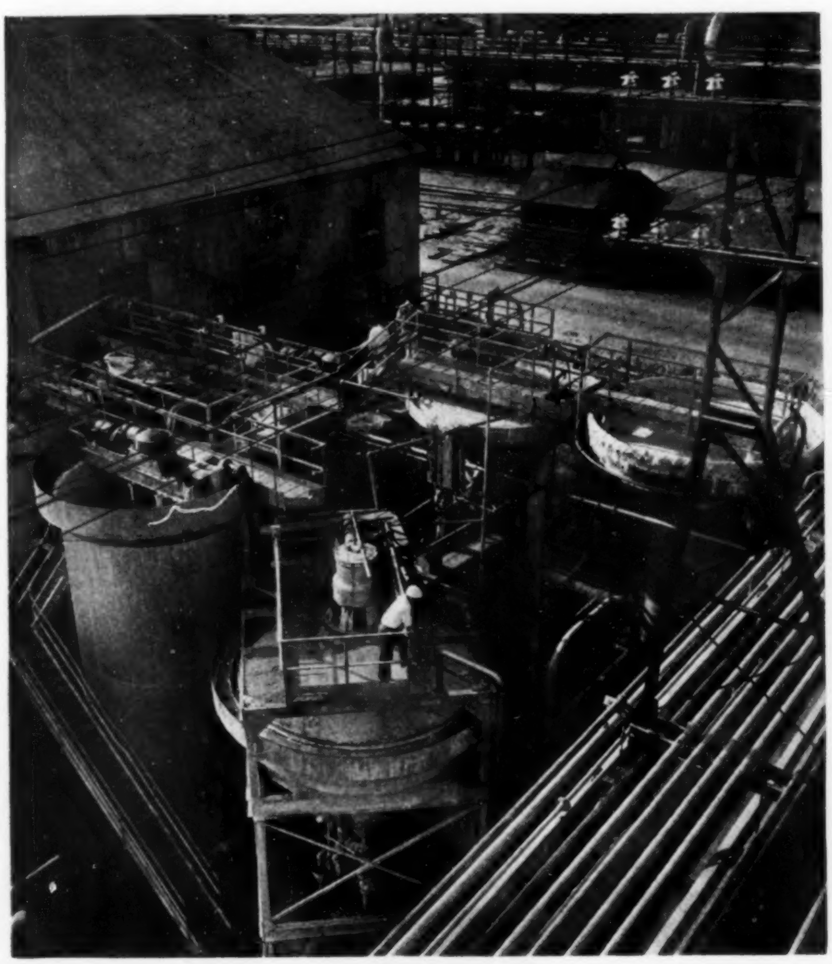
The Trona process for the manufacture of potash, borax, sodium carbonate and sodium sulphate is essentially that of evaporation followed by fractional crystallization. The composition of the Searles Lake brine is complex, but it usually contains the equivalent of about 15 percent sodium chloride, 7 percent sodium sulphate, 4-5 percent each of potassium chloride and sodium carbonate, 3 percent borax and about 64 percent water.

Raw brine pumped from the wells drilled below the crystal bed is first concentrated to precipitate sodium salts, then cooled to separate out potassium chloride and finally cooled further to crystallize the borax. Brine enters the plant at 72 deg. F. and is first used as a cooling agent in the potash vacuum crystallizer condensers before being used as evaporator feed and for the washing of the crystals. It enters triple effect vacuum evaporators, flowing counter to the heating steam and is thus progressively concentrated.

Part of the liquor from each effect is withdrawn together with the sodium salt formed into a multiple cone salt separator which has one cone for each effect. As the salts descend from cone to cone through orifices they are washed with less concentrated solutions and finally with raw brine. The washed solids discharge to vacuum filters, the cake going to the soda products plant, while the filtrate returns to the evaporators. The overflow from the cone separator flows to an auxiliary cone clarifier, the solids being filtered before going to the soda products plant, and the overflow goes to the potassium chloride crystallizer.

For recovery of KCl, a 3-stage vacuum crystallizer is used in which raw brine, borax mother liquor and water are all employed as cooling agents. The third stage discharges at 100 deg. F. to a settler, the underflow of which is centrifuged for KCl recovery, while the overflow goes to the borax plant. The crystals pass through oil-fired rotary dryers and then are stored or shipped. The potassium chloride mother liquor, on reaching the crude borax plant, is combined with mother liquor from the borax refinery, cooled to 75 deg. F. with ammonia refrigeration and the crystals settled in a Dorr thickener. The thickener underflow is filtered and the crude borax cake sent to the refinery. The filtrate and thickener overflow (crude borax mother liquor) return to the evaporators by way of the vacuum crystallizer condensers.

Giant digestors and other equipment in the soda products unit of the Trona plant of the American Potash & Chemical Corp.



Aromatics, Gas and Coke From Heavy Petroleum

E. L. HALL *Vice-President and Chief Engineer, Portland Gas & Coke Co., Portland, Ore.*

Chem. & Met. INTERPRETATION

Petroleum refineries are rarely well situated for the manufacture of aromatic chemicals by the cracking of heavy petroleum residues, since optimum cracking conditions yield large quantities of gas, tar and coke as well. On this account the author's company feels that a gas utility, being set up for gas making and marketing, is a logical place for such production. Portland Gas & Coke Co. has been a pioneer in this development and has experimented extensively with a variety of residuum cracking processes, one of which has been chosen for use in a $1,250,000 plant now under construction. Still another factor favoring this course is a rapidly expanding market for electrode pitch and coke in the Pacific Northwest.—*Editors.*

PRODUCTION of aromatics from petroleum is by no means a new art. As early as 1880 the Russians were familiar with the principles, and the working up of petroleum residues was even carried on industrially. However the processes then in use were crude and the operations of doubtful economic value. In more recent years, the carburetion of water-gas with gas oil, and later with heavy oil, has become a well-known source of aromatics.

There is an extensive literature dealing with the cracking of petroleum with the primary object of producing aromatics. The most notable investigation was that of W. F. Rittman who processed a light grade of petroleum in tubular apparatus (U. S. Bur. Mines Bul. 114). This operation was prompted by the World War shortage of toluol and was discontinued at the expiration of the emergency.

It is surprising, after such a long development period, during which time the chemical principles were thoroughly investigated, that the production of aromatics did not become more firmly established. Doubtless, the plentiful supplies of benzol and toluol from coal gas plants had much to do with this, which would seem to indicate that the manufacture of aromatics, except as byproducts of gas manufacture, has not been profitable. The production of aromatics from petroleum is accompanied by large quantities of gas, tar, and carbon and the disposal of these secondary products has placed too heavy a burden on any industry not having a market for the principal product, gas, and for tar and carbon as well.

Even the petroleum industry, which is a logical outlet for aromatics as motor fuel, has been similarly handicapped. Of recent years the oil industry has sought to produce aromatics by the catalytic cracking of selected hydrocarbons but such processes do not lend themselves to the employment of heavy residues.

Processing of petroleum for the production of aromatics is essentially a destructive distillation of high molecular weight hydrocarbons into new groupings of simpler structure, accompanied by side reactions and polymerization. Expressed simply, the cracking of petroleum (principally paraffines and naphthenes) follows somewhat this progression: High molecular weight paraffines→ olefines→(such as acetylenes, naphthenes, polycyclic compounds)→benzol, toluol, xylol, and higher homologues.

It is also true that in any one group the higher molecular weight compounds tend to split into lower molecular weight compounds, with scission of a radical. For example, butylene→propylene→ethylene, or xylol→toluol→benzol. However this general trend is also accompanied by alkylation and/or polymerization to produce higher molecular weight compounds, i.e., benzol→naphthalene, or benzol→ethylbenzol.

The final products from cracking petroleum, therefore, are numerous and non-selective. These reactions are functions of four variables, namely, temperature, time, pressure and concentration. The character of charging stock, aside from yields, does not materially change the nature of the resulting products.

Temperature, the most important variable, affects the cracking velocity

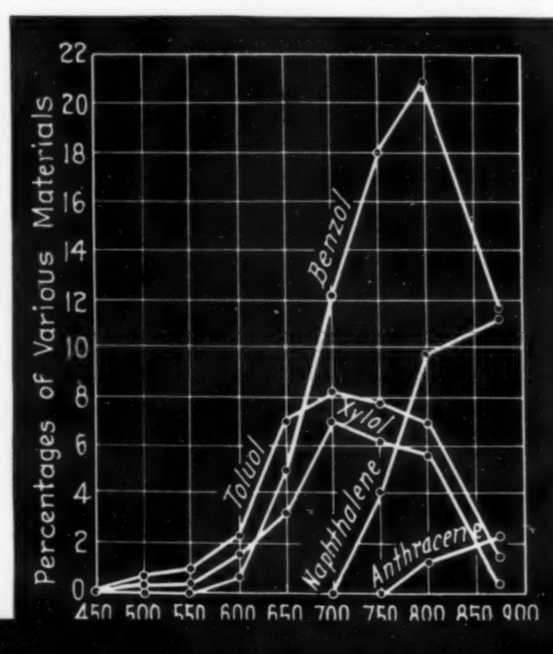


Fig. 1 — Production of aromatics at various temperatures, from data of Egloff and Twomey

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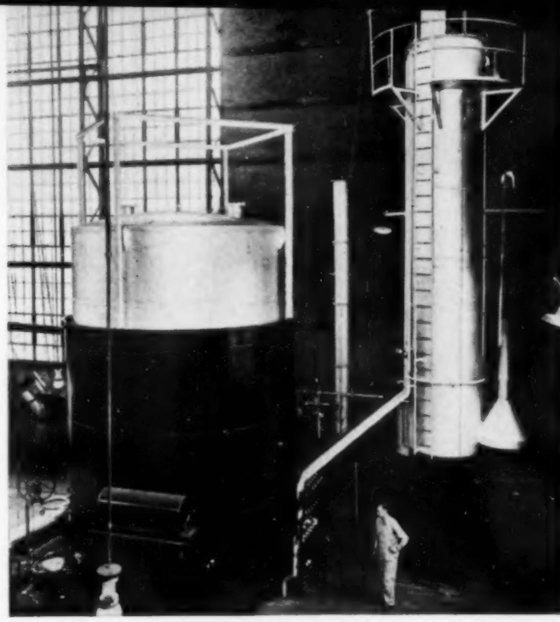
Residues



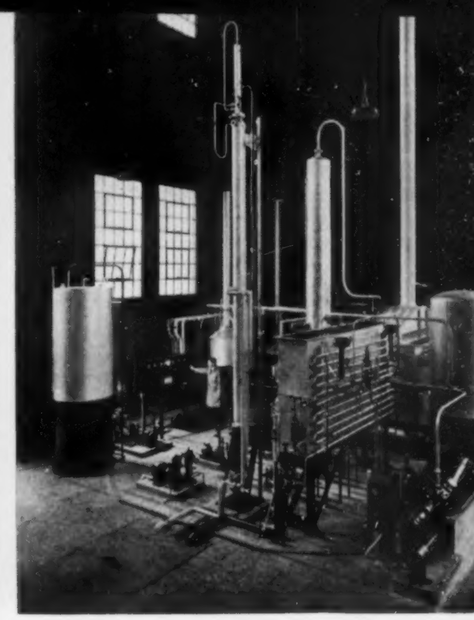


Fig. 3. Left—Oil gas generator pilot plant, for making rich oil gas, high in aromatics

Fig. 5. Right—Semi-commercial tubular type oil cracking unit of 2,000 gal. per day light oil capacity

by doubling the rate for each increase of 10 deg. C. in the cracking temperature, within the range of reaction. (See "Chemistry and Technology of Cracking," Sachanen and Tilicheyev, p. 28.)

Time, more conveniently referred to as "space-velocity," increases the cracking effect with longer duration, and vice versa. This effect is complementary to the effect of temperature, i.e., higher temperature and less time giving results similar to lower temperature and more time.

One effect of pressure is that higher pressures, by decreasing the volume, lower the space-velocity and increase the time of reaction. This effect is of course applicable to the reactions under consideration. However, the purely pressure effect, which is important in cracking for gasoline, does not favor the production of aromatics.

The cracking of petroleum to produce products in the range of olefines and naphthenes is endothermic, while the further cracking of these products into aromatics is exothermic. This is a very important consideration since "runaway" reactions may result from lack of proper time-temperature control.

PRODUCTS OF CRACKING

Finally, economic considerations of the relative values of the components in the resulting mixture of hydrocarbon products will dictate the cracking conditions, which naturally represents a compromise. The chart of Fig. 1 (from data of Egloff and Twomey, *Chem. & Met.*, Vol. 15, 1916) gives a general picture of the proportion of various aromatics resulting from the cracking of petroleum at various temperatures. Where the object of cracking is primarily the production of gas, as in gas works, much higher temperatures are employed than those shown in this chart, resulting in more gas and less aromatics. If the cracking is carried to the ultimate, the final products are carbon and hydrogen.

Oil Gas Manufacture—The manufacture of city gas from heavy petroleum is indigenous to the Pacific Coast, prompted initially by large and cheap supplies of petroleum from the California oil fields. Oil gas has been manufactured by Portland Gas & Coke Co., with which the writer is connected, since the year 1906. However, the usual process*, which is described in the accompanying footnote to facilitate an understanding of what follows, gives a relatively poor yield of aromatics, a fact which led to extensive research on aromatics production in which three different types of operation

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* Oil of any desired specific gravity is cracked in cylindrical shells lined with firebrick and filled with checker-work. (See flow diagram, Fig. 2.) The apparatus is fired intermittently with fuel oil, or by burning off the deposited carbon on the checker-work, with air supplied under forced blast. At the expiration of the heating period the air blast is discontinued, the stack valve closed and preheated oil is sprayed on to the checker-work which has been heated up to 1,800 to 2,000 deg. F. Gas making is discontinued after the temperature has been reduced several hundred degrees, whereupon the checker-work is purged out with steam and the apparatus is again heated up to the gas-making temperature.

The oil which has been pre-heated to a temperature of 200 deg. F. is progressively cracked as it passes down through the checker-work and finally issues from the base of the generator into a wash-box equipped with a water seal where a large amount of fluffy lampblack is deposited and removed by the water flowing in and out of the wash-box. The gas then passes into water scrubbers for the removal of tar and for further cooling. After passing through the usual relief holder, secondary coolers, exhausters, and gas purifiers, the gas is washed with an absorption oil for the removal of light oil (aromatics) together with all of the naphthalene and the larger portion of the organic sulphur.

Water coming from the wash-boxes is conveyed by flume to a Dorr thickener for concentration, and thence to an Oliver filter where the lampblack is recovered as a cake containing about 35 percent moisture. This cake is dried in rotary oil-fired dryers, similar to cement kilns, to about 12 to 15 percent moisture, and is then briquetted in a rotary press into pillow-shaped briquets which are coated with a starch solution, then dried and sacked. These briquets have a heating value on the dry basis of about 15,000 B.t.u. per lb. and command an excellent price as a domestic fuel.

Tar from the scrubbers and other parts of the plant is dehydrated and distilled to specification road-binder for paving purposes. For this purpose oil tar has been well accepted and has been widely used throughout Oregon.

After absorption the light oil is stripped from the wash-oil and refined into motor benzol, pure benzol and toluol. All of these materials are of exceptional purity. The motor benzol does not require acid washing and is only inhibited.

At the present time the heaviest type Dubbs cracked residuum from 6.5 to 8.5 deg. API is utilized. The use of such heavy residues was made possible by redesign of the oil gas generators in 1935, when the single generators were cross-connected in pairs at the bases, thereby making it possible to blast them in series; that is, alternately down one shell and up the other. In this manner it was possible to burn off the heavy deposits of carbon on the tops of the checkers resulting from this type of heavy oil, and at the same time do away with the use of heating oil.

Composition of the 570 B.t.u. oil gas is as shown in Table I, and the yield as in Table II.

Table I—Oil Gas Composition

Carbon dioxide	1.7
Benzol	0.1
Ethylene	3.4
Oxygen	0.3
Carbon monoxide	7.4
Hydrogen	51.5
Methane	31.7
Nitrogen	3.9
	100.0
Specific gravity	0.386
B.t.u. per cu. ft., gross	570

Table II—Yield of Products from 8.4 Deg. API Charging Stock

Feed, gal. per M cu. ft.	10.00
Gas, M cu. ft.	1.0
Lampblack, lb. per M cu. ft.	28.3
Tar, gal. per M cu. ft.	0.38
Light oil, gal. per M cu ft.	0.46

were worked out: cracking oil in gas generators of conventional design; in tubular equipment; and in Knowles ovens.

GENERATOR OPERATION

Prior to 1923 aromatics were not recovered by Portland Gas & Coke Co. although the gas was known to contain about a quarter of a gallon per M cu.ft. It is, of course, readily apparent from the fundamentals briefly set forth previously that the operating temperature of 1,800 deg. F. necessary to produce a 570 B.t.u. gas is much beyond the optimum point for the production of aromatics. This incidentally explains the high purity of the benzol.

With the object of producing larger quantities of benzol, sufficient to justify recovery, research was undertaken in 1920 and 1921. A process was devised whereby rich oil gas of over 1,300 B.t.u. was produced at the optimum temperature for the production of aromatics. This gas, after being stripped of the aromatics, was reformed to the regular 570 B.t.u. standard. During the reforming operation, additional benzol was produced.

A small gas works owned by the company in Vancouver, Wash., was converted into a pilot plant to study the process. Many data were gathered over a period of several months, resulting also in two different procedures for reducing the high B.t.u. gas to 570 B.t.u. standard: Procedure *A*, by reforming (Hall patent No. 1,409,709); and Procedure *B*, by blending the rich gas with a very low B.t.u. gas to accomplish the same result (Hall patent No. 1,466,648). The latter procedure, which may be operated by producing the low B.t.u. gas in another generator prior to blending, may also be accomplished in the same generator by making low B.t.u. gas at the beginning of the run and high B.t.u. gas at the end of the run.

Procedure *B* in practice produces less benzol than Procedure *A*, but was nevertheless adopted by the company because of the lesser capital investment required and constitutes the present operating method. Procedure *A* lay dormant until recently when it was revived as a part of the current research program.

The production of byproducts such as briquets, tar, benzol and toluol, has resulted in substantial revenues thereby giving Portland Gas & Coke Co. an extremely low cost for manufactured gas and has equipped the company to successfully meet the very severe electrical competition prevalent in the Northwest. It was natural, therefore, in the effort to offset losses of revenues due to rate reductions, to work for additional byproduct revenues. Of these, benzol, because of its high value per pound and available local market as motor fuel, offered the best opportunity.

After a survey of the available art, the most desirable procedure seemed to be the manufacture of high B.t.u. gas with reforming as outlined under Procedure *A* above.

During the year 1938, an oil gas generator pilot plant was built. This plant, illustrated in Fig. 3, consisted of a 4-ft. shell, 35 ft. high, built according to the same design as the large plant generators. A wash-box, scrubber, light-oil absorber and meter were provided together with a 2,000 cu. ft. storage holder. The plant was well instrumented, including a gas calorimeter and Ranarex specific gravity indicator. A still for distilling wash-oil was also installed.

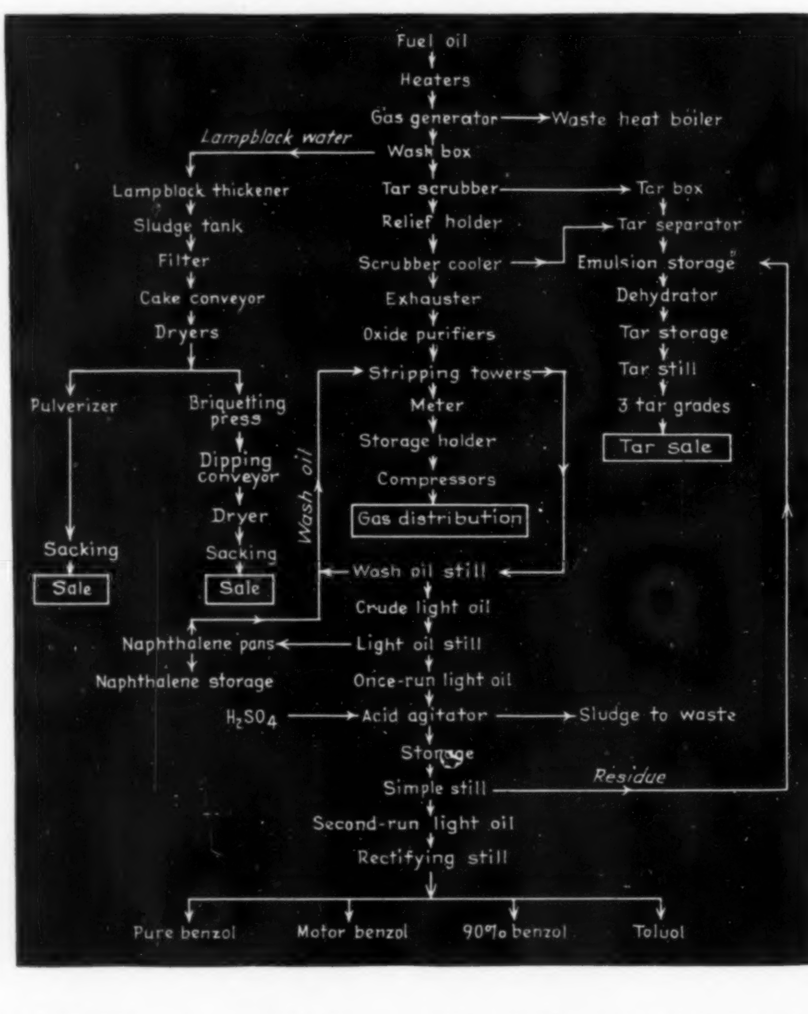
The pilot plant was first operated to produce the regular 570 B.t.u. gas in order to calibrate the plant in comparison with the large commercial generators. Thereafter the pilot plant was operated for about six months to produce various grades of high B.t.u. gas. This gas, after being stripped of light oils and stored in the 2,000 cu.ft. holder, was subsequently reformed in the same pilot plant generator. This was accomplished by taking the gas out of the holder with a small compressor and passing it through the pilot plant generator as in the gas-making operation. The reformed gas, after passing through the same auxiliary apparatus as before and being stripped of secondary light oil, was metered and sent to plant mains.

Various grades of heavy oil from 8 to 12 deg. API gravity were used; while cracking conditions were varied to produce high B.t.u. gas of from 950 to 1,350 B.t.u. per cubic foot.

The rates of flow were adjusted to give best space-velocity conditions. Such optimum conditions were obtained during each run by maintaining the gas issuing from the generator at constant specific gravity by means of the Ranarex indicator, there being a fixed relationship between the heat value of the gas and the specific gravity. There was also a constant relationship between the heat value of the gas and its benzol content, hence the production of aromatics could be controlled by the observation of specific gravity. This type of control is the subject of Hall patent No. 2,217,250.

An accompanying tabulation, Table III, summarizes the observations on

Fig. 2—Flow diagram of processes used by Portland Gas & Coke Co. in production of 570 B.t.u. gas, together with tar, briquets and aromatics



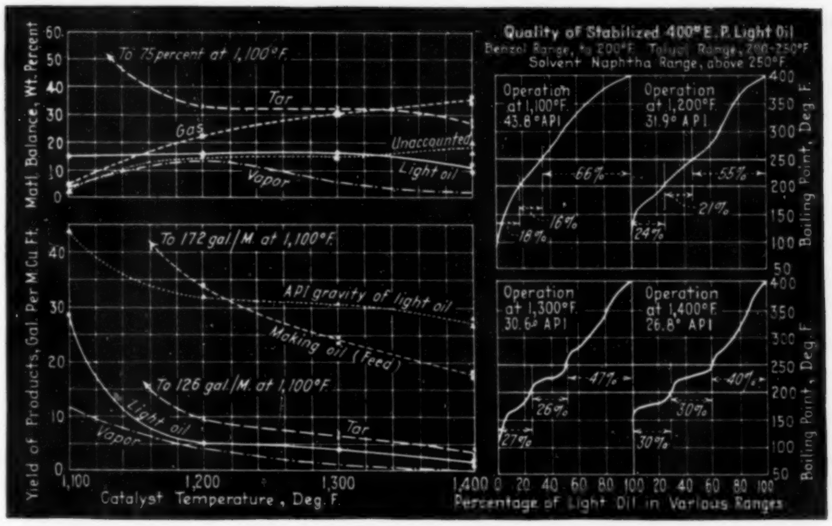


Fig. 4—Summary of cracking data obtained with tubular laboratory cracking unit, operating with a catalyst on a constant flow of 27.1 deg. API stock

12 deg. API oil, which is one of the conditions studied.

It was determined in various series of observations that space-velocity and temperatures were compensating, that is, results could be obtained with high temperatures and high space-velocities similar to those with low temperatures at low space-velocities.

After the completion of the pilot plant study, the operations were transferred to a pair of cross-connected generators for large scale experimentation. These generators were disconnected from the generator house mains and the wash-box and tar scrubbers were supplemented by a wash-oil absorber.

Instrumentation was provided to record oil quantity and rate of flow, with a Ranarex indicator for specific gravity of the gas and a calorimeter to give the heating value. Operation of the large scale apparatus gave substantially the same operating results as the pilot plant, although some difficulty was found in producing the tremendously high space-velocity utilized in the pilot plant because of the limitations in the oil piping system.

Reforming operations were not studied on a large scale since this operation is already a conventional one in the gas industry.

The quantities of tar produced in high B.t.u. operation are much in excess of the available market for road paving materials and the excess tar must be utilized for manufacturing 570 B.t.u. gas as a substitute for heavy oil in the regular generators. Hence, the gas-making value of the high B.t.u. tar was studied in pilot plant operation. In making 1,000 cu.ft. of 570 B.t.u. gas of 0.395 sp.gr., 18.30 gal. of making tar of 1.187 sp.gr. yielded 2.15 gal. of tar-gas tar of 1.195 sp.gr. and 0.50 gal. of light oils of 0.8849 sp.gr.

Table IV—Summary of Observed Data on Tubular Pilot Plant

Charging Stock	
Gravity, deg. API at 60 deg. F.	27.9
Viscosity, SUS at 77 deg. F.	47.
Viscosity, SUS at 122 deg. F.	35.
Molecular weight	193.
Distillation range, 99%, deg. F	358–688
Operating Data	
Test Number	59
Av. outlet temp., deg. F	1,435
Av. sp. gr. gas	0.95
Heating value, B.t.u. per cu. ft., gross	1,418
Feed per M cu. ft., gal	22.5
Prebenzol per M cu. ft., gal	1.06
Light oil per M cu. ft., gal	3.01
Naphthas per M cu. ft., gal	3.78
Tar per M cu. ft., gals	4.93
Total liquid products per M cu. ft., gal	12.78

Gas Analysis (Vol. %)

O_2	0	C_2H_6	10.10
N_2	0	C_3H_6	15.60
CO_2	0.40	C_4	6.90
CO	9.40	C_5	2.80
H_2	10.70	C_6	0
CH_4	34.40	C_7	0
C_2H_4	19.10		
			100.00

TUBULAR EQUIPMENT

Concurrently with the investigations for producing aromatics in the internally fired checker-work type of apparatus, tubular equipment was also explored, with and without the use of catalysts.

In this procedure it is, for obvious reasons, necessary to use a petroleum with a relatively low Conradson residue, as exemplified by a diesel oil. The type of laboratory apparatus used in this investigation consists essentially of a cracking tube preceded by a small vaporizer and a constant feed device. The apparatus is electrically heated and equipped with thermocouples. The cracking tube is followed by a water-cooled condenser and a dry ice freeze-out apparatus. Observation of specific gravity is by a Ranarex indicator, and of heating value, by a calorimeter. The results of trials at various temperatures are shown in Fig. 4. It will be noted from the distillation range of the products boiling within the motor fuel range that satisfactory aromatic content, as indicated by the benzol and toluol plateaus, was not produced until temperatures between 1,300 and 1,400 deg. F. were reached.

About the time this investigation was completed it was learned that the General Fuel Co. of Detroit had been working along parallel lines and, after some negotiations, it was decided to combine forces to prevent duplication and to expedite results. As a result of this arrangement a semi-commercial tubular cracking unit was designed by the Bechtel-McCone-Parsons Co., petroleum refinery engineers, and built by Portland Gas & Coke Co. at the company's plant. This pilot plant is illustrated in Fig. 5. It had a capacity of 2,000 gal. of light grade oil per day and consisted of a gas-fired furnace

Table III—Pilot Plant Yields With High B.t.u. Operation of Oil Gas Generators

(Charging stock, 11.7 to 12.0 deg. API cracked residuum)

Date of Run	6/3	6/2	6/1	6/7	5/31	6/6	6/10	6/4	6/8	6/9
Sp. gr. of lean gas (Ranarex.)	0.50	0.62	0.67	0.70	0.74	0.75	0.78	0.78	0.81	0.85
Oil used, gal. per M cu. ft	15.28	17.66	18.90	19.35	20.90	19.83	20.90	24.65	23.04	25.05
Light oil, gal. per M cu. ft	1.01	1.66	2.03	2.10	2.19	2.24	2.30	3.43	3.10	3.47
Tar, gal. per M cu. ft	4.54	7.41	5.20	7.13	8.90	8.40	8.34	11.10	8.44	11.28
Oil used, lb. per M cu. ft	125.4	145.5	155.2	158.8	170.0	163.0	171.6	203.0	189.0	205.5
Gas, lb. per M cu. ft	38.2	47.4	51.2	53.5	56.6	57.4	59.6	59.6	61.9	65.0
Light oil, lb. per M cu. ft	7.3	11.9	14.8	15.1	15.8	16.2	16.4	23.8	21.7	24.9
Tar, lb. per M cu. ft	40.8	66.7	47.1	64.2	80.1	75.6	75.0	99.9	76.0	101.6
Recovery, lb. per M cu. ft	86.3	126.0	113.1	132.8	152.5	149.2	151.0	183.3	159.6	191.5
Recovery, percent by weight	68.8	86.6	72.8	83.6	89.7	91.5	88.0	90.3	84.4	93.1
Light oil, vol. percent of making oil	6.6	9.4	10.7	10.9	10.6	11.3	11.0	13.9	13.5	13.9
Tar, vol. percent of making oil	29.7	42.0	27.5	36.8	42.9	42.3	39.9	45.0	36.6	45.0
Gas, weight percent of making oil	30.5	32.6	33.0	33.7	33.3	36.2	34.9	29.3	32.8	31.6
Light oil, deg. API gravity	30.8	29.9	30.1	31.9	31.7	30.9	33.8	37.0	35.6	39.2
Gas, B.t.u. per cu. ft. (gross)	946	1,075	1,125	1,194	1,208	1,254	1,295	1,308	1,318	1,362
Higher olefines in gas, vol. percent	3.4	5.1	8.0	9.6	12.6	11.1	13.6	13.2	15.0	16.5

containing alloy tubing, followed by a fractionating column for the separation of heavy residues from the gas and light oil. The overhead products, after cooling, were compressed to 650 lb. per sq.in. and the condensate was rectified in a stabilizer to separate the prebenzols from the light oil.

This plant was operated for about six months and produced an excellent grade of aromatics. The operation was quite critical on account of the production of carbon in the exit connections, but this mechanical difficulty was overcome by the installation of carbon removing devices. Operations were conducted with and without a catalyst, generally around 1,400 deg. F., and the results from a typical run are shown in Table IV. Control of the operation was principally by the specific gravity of the outcoming rich gas, since an excellent correlation between specific gravity and the degree of cracking was found to exist.

It was also found that the quality of light oil in regard to aromatic content was readily judged from the specific gravity of the fraction boiling below 422 deg. F., satisfactory aromatic content being obtained with light oil having an API gravity below 32. This quality was generally associated with a gas specific gravity of 0.9 or less. It will be noted that the percentage yield by volume of aromatics from the 27 deg. API charging stock was greater than the corresponding yields in the generator type of operation from 12 deg. oil. This comparison is, however, somewhat misleading since if the 12 deg. oil is evaluated for its diesel oil content, the results are surprisingly similar.

KNOWLES COKE OVEN

The manufacture of 570 B.t.u. oil gas in checker-work generators produces as a byproduct large quantities of lampblack. This material, when briquetted, produces a high type of domestic fuel, but is not well suited for electro-metallurgical purposes where petroleum coke finds its field. Portland has lately become the Mecca for electro-metallurgical and electrochemical processes because of the advent of cheap power from the Bonneville development on the Columbia River. The aluminum industry, represented by the plants of the Aluminum Co. of America and the Reynolds Metals Co., has located in the Portland area and requires large amounts of petroleum coke for the manufacture of electrodes. This material is not produced in the Northwest and must be imported.

Consideration was therefore given by Portland Gas & Coke Co. to the manufacture of electrode coke from petroleum. After considerable study of the available apparatus Knowles ovens were selected for this purpose, and an investigation was carried on jointly with the H. A. Brassert Co. of New York resulting in the building of a pilot coke oven.

This oven consisted of an insulated brick chamber approximately 3 ft. wide, 6 ft. long and 8 ft. high outside, with a hearth of silicon carbide, and walls about 1 ft. thick including the insulation. The oven was equipped with doors at either end for the removal of coke and was fired under the hearth by gas burners. A gas-fired silicon carbide muffle was provided in the upper part of the oven for superheating the gases from the distillation of oils, and a gas offtake communicating with the gas condensing and recovery apparatus already available in the generator type pilot plant. The investigation had two objectives: (1) to produce a type of coke suitable for the production of electrodes, and (2) to crack the overhead materials sufficiently to produce a satisfactory grade of aromatics. Trials demonstrated that both objectives could be achieved. An 8½ deg. API Dubbs cracked residuum was utilized for the investigation, the results of which are given below in Table V.

Knowles ovens have heretofore been used for the cracking of heavy petroleum residues in the oil industry, with the object of producing products in the range of gasoline and gas oil, and of getting rid of the carbon residue. The fractionation of aromatics in the Portland Gas & Coke Co.'s operation is a new objective and requires cracking at elevated temperatures and with modifications of the oven design.

Character of Aromatics—Consideration of the fundamentals set forth at the beginning of this paper makes it apparent that the yield and quality of aromatics produced by cracking are the result of the proper application of temperature and space-velocities. Therefore, the choice of charging stock and of apparatus are merely matters of economics.

Portland Gas & Coke Co.'s investigations were directed primarily to the production of aromatics of relatively high purity, susceptible to being refined into specification products. It was desired to produce a grade of light oil of such a quality as to minimize refining difficulties, that is, under conditions of cracking sufficiently severe to eliminate most of the gum-forming diolefines. The light oils produced from the three methods described were generally of the same character when produced under similar cracking conditions. It was found that the light oil responded in a satisfactory manner to the usual refining methods employed in making motor benzol, pure benzol, pure toluol and the various other specification products usually obtained from coal tar. As an instance of the satisfactory quality of these light oils, it may be said that nitration toluol free from paraffines is readily prepared. It may be generally stated that light oil manufactured from petroleum under proper cracking conditions is in every way equal to the light oil from coal gas or coke oven plants.*

Oil tar from the coke oven is quite similar to that produced from the generator type of operation and is equally suitable for the preparation of road binders, briquetting and electrode pitches. The oil coke from Knowles ovens can be processed either to metallurgical or foundry coke, or to the high density coke required for the manufacture of electrodes.

Olefines—The lean gas after stripping of aromatic contents has an analysis as shown in Table VI. It will be noted that substantial quantities of ethylene, propylene and butylene are present in this gas. These products can be readily recovered by a combination of absorption, compression and refrigeration and are pres-

Table V—Coke Oven Pilot Plant Yields

Run No	67
Feed, deg. API	8.4
Feed, gal. per M cu. ft	17.8
Gas, M cu. ft	1.0
B.t.u. per cu. ft., gross	1,038
Specific gravity	0.64
Light oil, 422 deg. E. P., gal. per M cu. ft.	2.15
Tar, gal. per M cu. ft	6.08
Coke, lb. per M cu. ft	22.68

Table VI—Lean Gas Composition

	Volume Percent
Carbon dioxide	0.20
Carbon monoxide	1.54
Oxygen	0.58
Hydrogen	22.74
Methane	43.59
Nitrogen	4.46
Ethylene	10.44
Ethane	7.20
Propene	6.00
Butenes	2.08
Pentenes	0.63
Hexenes	0.54
	100.00
B.t.u. per cu. ft., gross	1,038
Specific gravity	0.6379

* There is one distinct difference between the light oils and tars produced from petroleum and those produced from coal, which is the practical absence of oxygenated and nitrogenous compounds such as phenols and pyridine bases, only traces of these materials being present. On the other hand, the higher boiling fraction of oil tar corresponding to the creosote oil fraction in coal tar is also an excellent wood preservative. An investigation of the merit of oil tar creosote prepared by Portland Gas & Coke Co. has been made by Prof. Glenn Voorhies of Oregon State College and the results of his investigation have been published in Oregon State College Engineering Experiment Station Bulletin No. 13, entitled "Oil Tar Creosote for Wood Preservation." This investigation indicates that phenols are not necessary to a good wood preserving creosote and in fact are generally removed from coal tar creosote; and that because of the volatility of phenols their preservative value is of short duration.

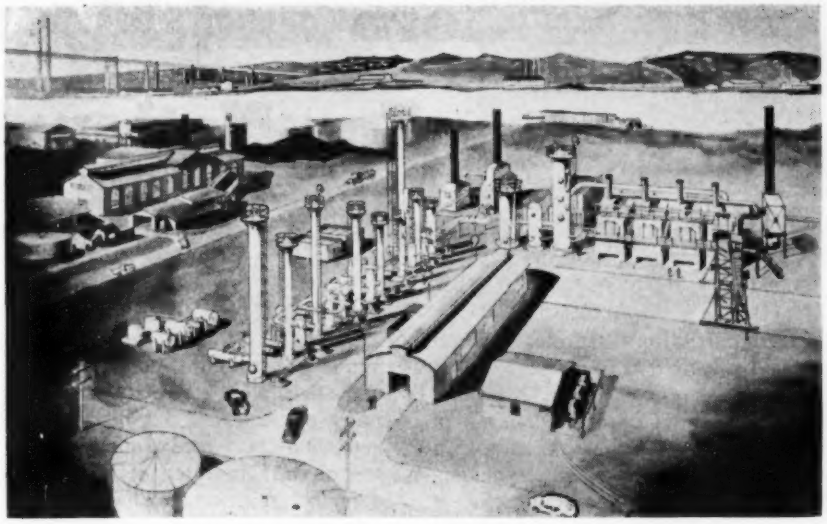


Fig. 6—Artist's drawing of new heavy-residuum cracking plant, using Knowles ovens, being built by Portland Gas & Coke Co. for byproduct production

ent in considerably larger amounts than in the cracking gases from oil refineries.

These olefines constitute a cheap and substantial supply of raw material for numerous synthetic organic chemicals. Availability of these hydrocarbons in the Northwest is particularly important in view of cheap electric power for the production of chlorine and caustic soda, which are generally the tools for converting the olefines into the numerous plastics and other products which have become so important to industry in the past few years. In a following section the utility of these products will be illustrated.

BYPRODUCT DEVELOPMENT

The research program briefly described above gave Portland Gas & Coke Co. the choice of several methods for the production of aromatics and the decision became a matter of economics. The Knowles coking oven method was finally chosen because, in addition to producing all of the byproducts given by the other methods, it also produces petroleum coke.

Therefore, we are now building four Knowles coke ovens for the processing of 8½ deg. API Dubbs cracked residuum. These ovens will be supplemented by light oil recovery apparatus together with additions to the existing light oil refinery which will permit the production of additional motor benzol and toluol, together with specification xylols and solvent naphthas. The tar will be processed to electrode pitch and road binder in existing tar distilling equipment.

Surplus tar will be used as a substitute for generator fuel in the existing oil gas generators, for which purpose tankage and piping connections will be provided. Lean gas after the removal of light oil is of approximately 1,100 B.t.u. and will be reformed in the existing oil gas generators to the required standard of 570 B.t.u., during which operation additional quantities of light oil and lampblack will be produced. It is expected that this plant, which will cost about $1,250,000, will be ready for operation in December of this year. An artist's drawing of the completed plant is shown in Fig. 6.

From this development, including existing facilities, Portland Gas & Coke Co. will produce annually byproducts including 3,350,000 gal. of benzol, 540,000 gal. of toluol, 320,000 gal. of xylol, 317,000 gal. of solvent naphtha and 2,500,000 gal. of road tar; in addition, 42,000 tons of briquetted lampblack, 21,000 tons of electrode coke and 15,000 tons of electrode pitch. Not initially recovered but available for future production annually will be 3,000,000 gal. of creosote oil and 14,000,000 lb. of ethylene, 12,000,000 lb. of propylene and 6,000,000 lb. of butylene.

The gas industry is a logical collaborator of the oil refining industry for the most advantageous and economic processing of petroleum, a fact which is true principally for two reasons: (1) The gas industry can process petroleum advantageously at operating temperatures suitable for the production of aromatics, since the production of large quantities of gas does not constitute a limitation. (2) The petroleum industry, however, can process petroleum advantageously only to a point where the residues are sufficiently fluid for transportation. If the oil is processed to coke, the local market must be depended upon in view of freight limitations. Only in favored locations are the local markets large enough to absorb the quantities involved.

GAS INDUSTRY OPPORTUNITY

Thus it seems apparent that the gas industry can with advantage carry on the processing of petroleum from a point where the oil industry leaves off. To be sure, the petroleum industry can produce aromatics by selective extraction of materials containing small quantities of aromatics or by the catalytic cracking of selected hydrocarbons, but it is not believed that such methods can compete with aromatics produced by the gas industry from the heaviest petroleum residues.

There is a real opportunity for the gas industry to take its place in the sun as a purveyor of hydrocarbons to the chemical industry. There are few industrial organic chemicals that can not be synthesized directly or indirectly from either olefines or oromatics. To mention only a few of these, motor fuels, phenol, amines, styrene, lacquer solvents and explosives can be derived from the aromatics produced. With the recovery of methane and ethane, in addition to the olefines mentioned, alcohols, esters, resins, high anti-knock motor fuels and other organics such as glycols can be made. From the tar, road and roofing materials, pitches, paints and wood preservatives are all recoverable, and from the carbon, all types of coke and carbon products, as well as carbon derivatives such as CaC_2. In fact the future of the manufactured gas industry in its intense competition with other fuels may well depend upon the capitalizing of these opportunities.

Acknowledgment—For their valuable contributions to the above investigations the writer extends his grateful acknowledgments to his associates in Portland Gas & Coke Co., Norman H. Wardale, S. C. Schwarz, J. K. Lehman, and the laboratory staff; as well as to C. T. Draney of Bechtel-McCone-Parsons Co., U. H. Stallings of H. A. Brassert Co., and Profs. George H. Gleeson and Glenn Voorhies of Oregon State College. This project is indebted to Paul B. McKee, president of Portland Gas & Coke Co., for his constructive vision and sympathetic support.

New extrusion mill at Vernon, Calif., works of Aluminum Company of America, soon to have a capacity of more than a million pounds of extruded shapes per month

More and More For National

An Editorial

WESTERN PLANTS are doing their share to make more aluminum in the United States than in all of the rest of the world combined. According to plans announced in Washington late in August, further expansion of production facilities during the next 15 months will bring this country's total annual capacity to 1,500,000,000 lb. This is to be compared with an output of 327,000,000 lb. in 1939, of approximately 420,000,000 lb. in 1940 and a present estimated capacity of about 900,000,000 lb. Of these newest plants to be government-financed, but privately built and operated, it is expected that at least four will be located in the Far West. The Defense Plant Corporation has already announced that Alcoa will build and operate a second plant in the Portland, Ore., district with 90,000,000 lb. of annual capacity. Alcoa will also add 150,000,000 lb. of smelting capacity at Massena, N. Y., and construct a third metal plant in Arkansas with a capacity of 100,000,000 lb. It will also build a 40,000,000 lb. alumina plant in Arkansas for the government.

While the contracts with the operating companies for the other western plants had not been officially consummated by September 1, an announcement from OPM indicated that Union Carbide & Carbon Corp. would probably build and operate a 60,000,000 lb. plant at Spokane, Wash.; that Bohn Aluminum & Brass Co. would build a 70,000,000 lb. plant in the Los Angeles or Boulder Dam area, and that the Olin Corporation had been selected for a 30,000,000 lb. plant in the Tacoma, Wash., district. It was indicated that Alcoa engineers would assist in the design and construction of at least two of these plants and help to train the necessary operating personnel—all without profit to itself.

Further contribution to the national defense is noted in that company's recent announcement that as of October 1, 1941, the price of ingot aluminum is to be reduced another 2 cents—from 17 to 15 cents per lb. This is the fourth reduction in 18 months, prior to which time aluminum sold at 20 cents per lb. The immediate beneficiary is Uncle Sam who is buying almost the entire output. After the emergency demands are over, these lower prices will undoubtedly open wider peacetime markets for this metal.

Pictured on these pages are two West Coast plants—financed, built and operated by the Aluminum Company of America out of the $200,000,000 of its own funds which it has already invested in the national defense program. The company's new metal producing plant at Vancouver, Wash., originally intended to produce 30,000,000 lb. of ingot yearly went into operation in 1940 with a capacity of 60,000,000 lb. and has now been further expanded to produce more than 150,000,000 lb. annually. This is as much as the entire aluminum industry made in this country in 1924. Alongside the plant to make the metal, there has also been installed capacity to make the 120,000,000 lb. of carbon electrodes per year used in the reduction furnaces which reduce the alumina to the metal.

The Vernon works of the Aluminum company, on the outskirts of Los Angeles, started out in 1938 as a single small plant capable of turning out the few hundred sand castings required by the airplane industry in those days. When it became necessary to speed the flow of aluminum for the nation's greatly accelerated defense program, the Vernon

Airview shows how the Vernon works was expanded 455 percent in buildings since Germany over-ran Poland in 1939. Aluminum alloy forgings, extruded shapes, rivets and sand- and permanent-mold castings are made here

Four of the 21 hammers in Vernon works that are producing forgings for national defense even before the floor has been completed in the building

Aluminum Defense

Summary

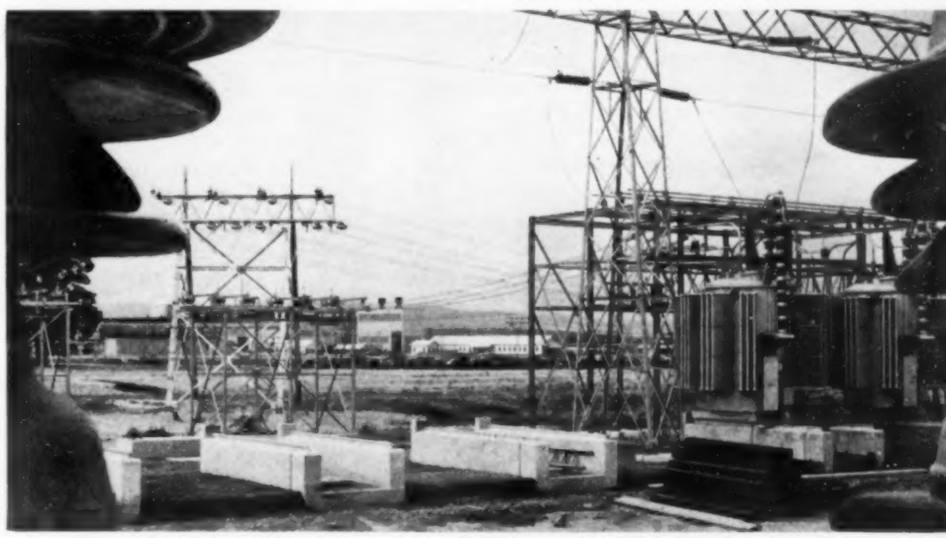
plant area was increased 455 percent. New buildings are being erected and new equipment is being installed for the increased production of aluminum forgings, sand and permanent mold castings, and other items of aluminum needed for aircraft. There are now 21 forging hammers at the Vernon works, busy 24 hours a day, pounding out the high strength aluminum parts which make America's planes out-perform any in the world. When all equipment on order has been installed, the capacity of the Vernon works on forgings will have been increased by 350 percent in less than a year.

The Reynolds Metals Co.'s plant at Longview, Wash., just now getting into operation, is expected to climb to a capacity production of 60,000,000 lb. of aluminum ingot per year by about October 15. The alumina will be supplied from the company's mill at Lister, Ala. Alcoa's plants are supplied with alumina from greatly expanded facilities at Mobile, Ala., and East St. Louis, Ill., and will be served later by the new Arkansas mill.

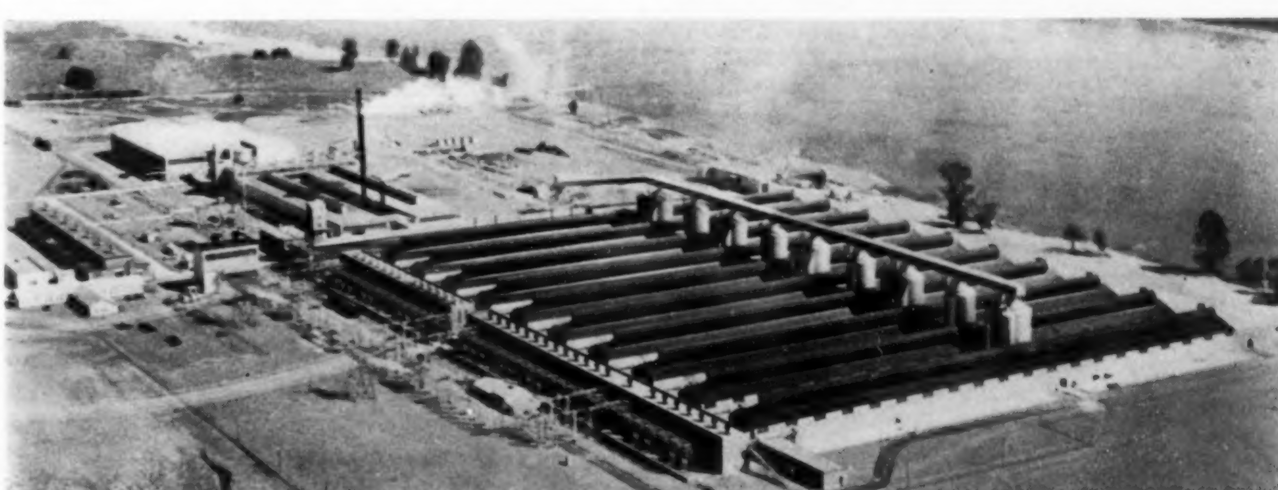
Thus, a completely integrated industry, the largest in the world, continues its phenomenal advance.

Electrical energy for the great aluminum works at Vancouver, Wash., comes from Bonneville Dam

Bonneville transformers installed at substation. Alcoa's line and Vancouver plant in rear



Vancouver plant 15 months after construction started. Five metal-producing units, each capable of turning out 30,000,000 lbs. of aluminum a year, were in operation by June 1, 1941. This 150,000,000 lb. annual production is in excess of our entire capacity during World War I and yet is only 10 percent of the aluminum that will ultimately be available



Power Rectification in Aluminum

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Chem. & Met. INTERPRETATION

Much of the rapid growth of the electrochemical industries can be traced to improvements in methods of converting power from alternating to direct current. In this article the authors describe in detail the Ignitron mercury arc rectifiers, which have shown remarkable progress since their introduction in 1937 by Westinghouse Electric & Manufacturing Co., now in use for the reduction of aluminum at the Vancouver plant of the Aluminum Co. of America.—*Editors.*

As in all cases where metal is deposited by electrochemical means, the production of aluminum requires direct current power, and aluminum reduction units require relatively large amounts of such power. Since the superiority of modern alternating current generating equipment over direct current generating equipment has dictated that practically all power be generated as alternating current, and particularly where it is to be taken from one of the existing high power networks, the need for direct current power requires conversion equipment. In the reduction of aluminum, the prime requisite for this conversion equipment is reliability, and it is essential that any conversion device must have proved itself before it can be applied in this field. Also, since an electrochemical process operates continuously at full load, the efficiency of the conversion unit is an important factor in its selection.

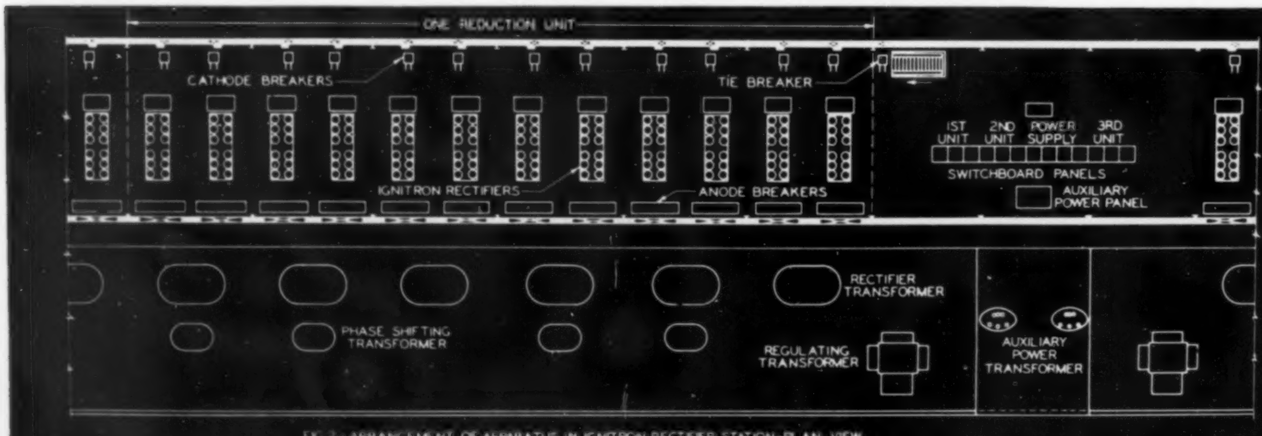
Earlier aluminum plants were supplied with synchronous converters. Although this equipment was satisfactorily reliable, it had the disadvantages of high maintenance cost, time required for placing many units on a bus, and noise. Because of these objections, the mercury arc rectifier was welcomed by the aluminum industry after it had progressed to a point where the question of reliability did not cause too much concern. The earlier rectifiers were of the multi-anode continuously-excited type, and their performance was such that after about 1930 all major expansions in aluminum plants throughout the world employed mercury-arc rectifier conversion equipment rather than synchronous converters.

Although the multi-anode continuously-excited rectifier was a great improvement over the rotating device, it fell short of utilizing the inherent possibilities of the mercury vapor arc. This is illustrated by the fact that the large size multi-anode rectifiers have a voltage drop loss of the order of 29 v., whereas the arc drop of a simple mercury vapor arc is 10 v. or less. The large multi-anode rectifier just about equals in efficiency the rotary converter at full load. In order to maintain reliability to a satisfactory degree, the arc drop in a multi-anode rectifier cannot be reduced appreciably. However, in the Ignitron rectifier,[1,2] with its intermittent excitation and short arc path, the arc drop more nearly approaches the theoretical minimum with the same degree of reliability.[3] In addition to the advantage of improved efficiency, the Ignitron, being made in single anode tanks, is quite flexible in arrangement and requires a minimum of spare capacity for any given requirement. Its smaller vacuum volume requires a relatively short processing time.

EXPERIMENTAL INSTALLATION

Before any important application of Ignitrons for aluminum reduction could be considered, it was essential that the device be proved on an actual aluminum plant bus to demonstrate its ability to carry full load continuously over long periods with-

Fig. 2—Apparatus arrangement in the Ignitron rectifier station of the Vancouver plant of the Aluminum Co. of America



Production

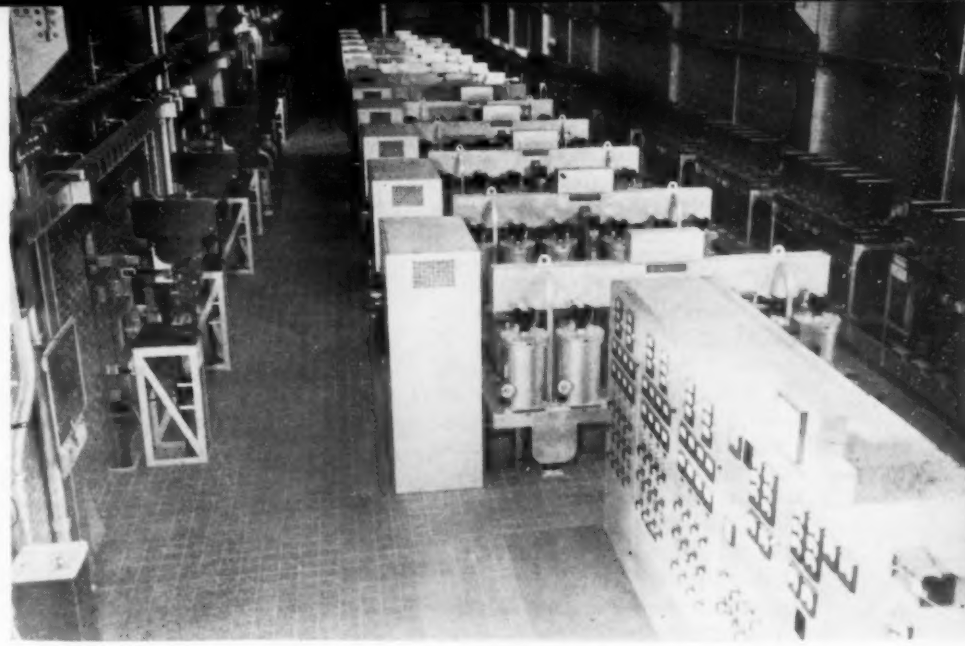


Fig. 1—General view of the rectifier floor of the aluminum plant at Vancouver

out serious deterioration. To provide such a demonstration, the Aluminum Co. of America and the Westinghouse Electric & Manufacturing Co. cooperated in the installation of an experimental Ignitron on an operating bus of an aluminum reduction plant at Massena, N. Y. This unit consisted of an assembly of six single-anode Ignitron tanks which laboratory tests indicated should have a nominal rating of 100 kw. at 600 v. The unit was operated for nearly a year. During the major part of the time the load was 1200 to 1500 kw., but for a part of the period the unit carried 1800 kw. This test definitely demonstrated that the Ignitron would withstand service on a high power bus and that it had a reliability factor which measured up to that of other forms of conversion apparatus. The unit was operated for a time with one anode out of service. Ability to operate in this manner is an added safety factor.

PLANT INSTALLATIONS

When the Aluminum Co. of America initiated the large expansion program necessitated by National Defense, it was considered that the trial Ignitron unit had sufficiently demonstrated the prime requisite, reliability, to dictate the use of this type of equipment over the other types previously used. At the present time there are five aluminum reduction units supplied by Ignitrons in operation in the Vancouver, Wash., plant of the Aluminum Co. of America. A typical unit will be described.

Figure 1 shows a general view of the rectifier floor, Figure 2 a plan view in outline, and Figure 3 a simplified circuit diagram. A station unit consists of 12 Ignitron rectifier sections, each section complete in itself except that two sections are fed from one transformer. The Ignitron rectifier consists of 12 single anode tanks mounted on a single frame with common vacuum and water cooling systems, the latter including the circulating water pump mounted underneath the rectifier frame. Figure 4 shows a view of this assembly. Each tank has a separate vacuum valve so it can be treated as a separate item and replaced if necessary.

Control apparatus for both vacuum and excitation devices is mounted in a single cabinet for each rectifier section, located on the floor adjacent to the Ignitron. The vacuum system is of a long-established type, utilizing a three-stage mercury vapor high-vacuum pump, an interstage reservoir with barometric seal, a rotary oil-sealed backing vacuum pump and both manually operated McLeod and indicating hot-wire vacuum gauges. The excitation system is of the saturating reactor type making use of capacitors, charged through linear reactors from an alternating current auxiliary transformer, and discharged at the proper point in the cycle through a saturating reactor and the ignitor to start the arc. This system makes use of static devices throughout without thermionic control tubes.

Fig. 4—Anode tanks of an Ignitron rectifier mounted on a single frame with common vacuum and water cooling systems, including a circulating water pump beneath the rectifier frame. Each tank has a separate vacuum valve

Although all parts of the cooling system of the Ignitron are nonferrous throughout, in order to eliminate the accumulation of sediment or scale in the Ignitron water tubes the cooling is done through heat exchangers which use raw water from the plant supply. By locating the circulating water pump on the rectifier frame, all rectifier items requiring frequent inspection are located on the rectifier floor. The use of untreated water made possible by nonferrous cooling spaces permits solid grounding of the heat exchanger without excessive insulating hose length or electrolysis at the nipples or targets.

Transformers are connected to the anodes through high-speed anode breakers, and by the use of anode balance coils two anodes are supplied from one transformer phase with one breaker pole. Figure 5 shows a six-pole breaker unit. The anode breakers are motor gang operated,

individually trip free and with individual high-speed biased reverse and forward current trip. The speed of operation limits the current rise to 0.5 cycle on a 60 cycle basis. The high speed anode breakers, disconnecting both the d.c. and a.c. power sources quickly in the event of an arcback, minimize the duty on all elements. The use of these high-speed anode breakers eliminates the necessity for oil circuit breakers, or the equivalent, in the rectifier transformer primaries, disconnects only being provided.

The case of each rectifier transformer is grounded through a special current transformer and relay, which will trip out the main switches feeding the station in the event of an internal rectifier transformer fault. A semi-high speed cathode breaker carrying main rectifier output is connected between the rectifier and the positive bus. It acts to provide backup protection and, by group tripping, an entire section of reduction load can be disconnected.

The station is controlled from a central switchboard on which are mounted the control switches for all breakers and voltage control phase shifters, station control relays and the indicating meters over which the station operator needs continuous supervision. In order to achieve a satisfactory compromise between simplicity of station wiring and convenience of operation, those instruments and control switches which the station operator needs to have at a central location are on the main switchboard and those which require only infrequent attention are on the individual rectifier cubicles.

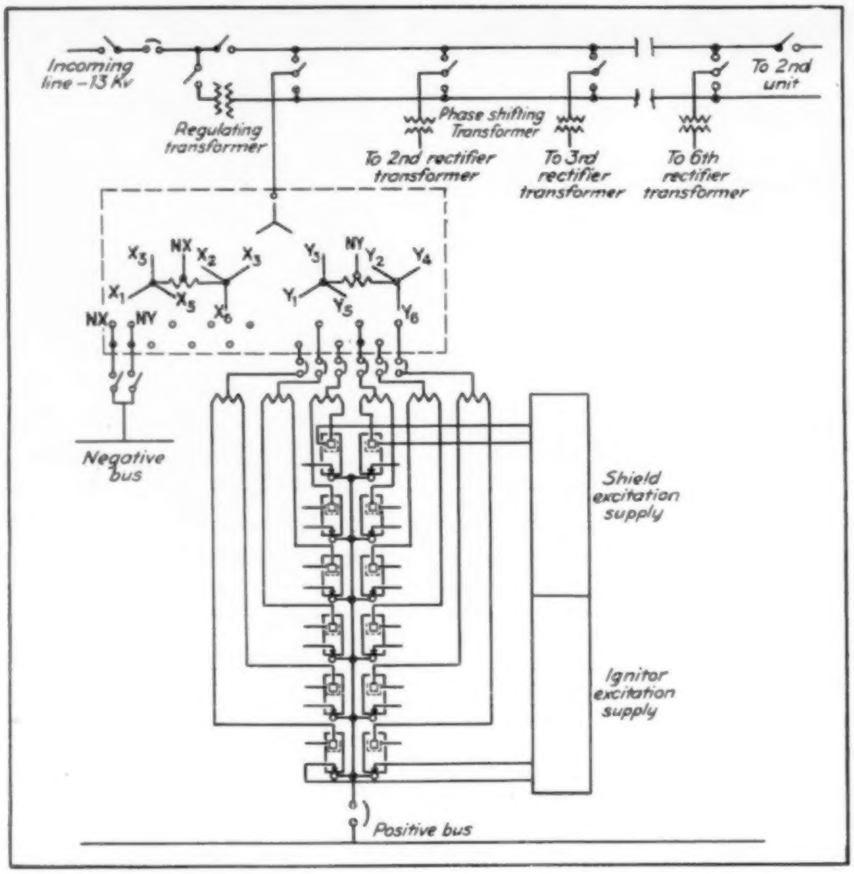
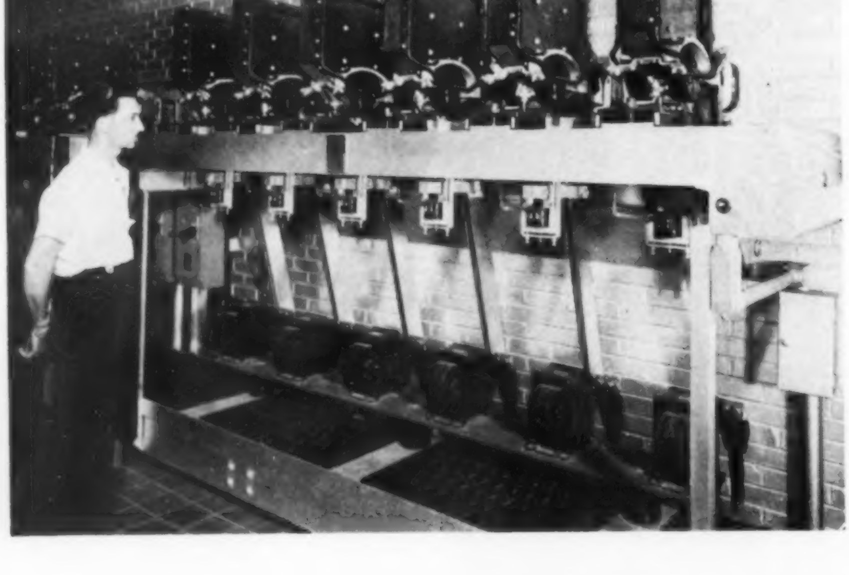


Fig. 3—Simplified circuit diagram of Ignitron rectifier station at Vancouver

As mentioned before, one transformer feeds two rectifier sections, with a total capacity of 10,000 amperes at 645 v. By building some transformers with delta primary and others with star primary, and by the use of phase shifting transformers in the primary supply to each rectifier transformer to shift the phase position of the supply voltage either ± 10 degrees, the entire station operates as a 36 phase unit.[4] Earlier experience showed that with operation at 30 or more phases, even a large station does not produce objectionable harmonics in the a.c. system which might cause trouble by influence on communication circuits or the heating of the supply generators.

Fig. 5—Six-pole, high-speed anode breaker, 1600 amperes per pole, 750 volts, d.c.



The first aluminum reduction unit supplied with Ignitron rectifiers was placed in service late in August 1940. Units have since been added so that at the present time there are sixty 5000 amp. units in operation.

Arcback frequency has been maintained at a satisfactorily low level, and no operating troubles other than of a minor nature have been experienced. The excitation scheme employed has operated excellently.

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Western Wastes as Materials For Alcohol Production

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Chem. & Met. INTERPRETATION

Present capacity for ethyl alcohol production on the Pacific Coast is not sufficient to continue present uses and also supply requirements for a projected military explosives plant in the Northwest. This article surveys the wastes and culls available in or near the region of the proposed plant, from which alcohol could be made. Sulphite waste liquors appear to offer the best possibilities, although tremendous wood wastes might be used, while smaller quantities could be made from beet sugar molasses, fruit canners' wastes, cull potatoes and by synthesis from ethylene or acetylene.— *Editors.*

In the course of a survey of available raw materials for a military explosives plant (combined smokeless powder and TNT) for the Pacific Northwest, a serious deficiency in industrial alcohol supplies was discovered. However, at the same time certain fermentable agricultural and other cull and processing wastes were found to exist in apparently adequate quantities to meet any anticipated deficiency. Recovery plants would have to be built to produce needed alcohol supplies; but could be put into operation by the time the explosives plant itself was ready to take the alcohol.

The size of the smokeless powder plant proposed would require about 55 tons per day of 95 percent alcohol, or over 19,000 tons per year of 350 days.

The Pacific Northwest faces this manufacturing problem possessed of only a pilot plant (cull potato), capable of producing only 720 proof gal. per day, or about 2½ tons, and with neighboring California's total production only 18,900 tons annually.

In reaching a logical solution to this supply problem, disabling diversions from present markets must be avoided. Consequently attention is directed to the following six potential sources of raw materials within or adjacent to the Pacific Northwest. In Table I these are listed in descending order of estimated possible importance.

Table I—Six Potential Sources for Northwest Industrial Alcohol
(Est. annual tons of alcohol)

1. Sulphite waste liquors from Northwest pulp mills	51,974
2. Hydrolysis of wood wastes	5,277,000
3. Fruit canners' rejects	26,556
4. Beet sugar molasses	7,250
5. Starch from cull Idaho potatoes	4,756
6. By synthesis from the ethylene recovered from city gas in Portland and Seattle, and from acetylene produced from the calcium carbide now made by Pacific Carbide & Alloys Co., Portland, and soon to be manufactured by Electro Met. Co., also in Portland.	(?)

1. Sulphite Wastes—According to R. S. Hatch, director of research of Weyerhaeuser Timber Co., Longview, Wash., sulphite waste liquor contains a certain amount of fermentable sugars, and it is possible by proper fermentation methods to recover approximately 12 gal. of 95 percent ethyl alcohol from each 1,000 gal. of waste liquors.[1]

It is estimated that some 1,275,000,000 gal. of waste sulphite liquors are produced annually in the Pacific Northwest. Therefore, from this source alone 15,300,000 gal. of 95 percent alcohol are possible annually. This yield corresponds to 103,948,200 lb., or 51,974 tons annually.* After the recovery of alcohol, some 825,000 tons annually of unfermentable organic material would remain from which to develop other products, such as industrial carbon.

Such recovery of alcohol is practiced in 17 mills in Sweden and therefore is beyond the laboratory stage.

Interesting verification of these figures came from a Puget Sound pulp company through the good offices of H. K. Benson, head of the department of chemistry and chemical engineering at the University of Washington, and from L. C. Haffner, consulting engineer, as shown in Table II.[2]

2. Hydrolysis of Wood Wastes—Due to the fact that the Pacific Northwest has very large lumbering, pulp and paper industries, the feasibility of securing needed supplies of industrial alcohol from logging and sawmill wastes was investigated. Any major effort to produce byproducts from the wastes left in the woods after logging operations would go far toward eliminating dangerous fire hazards while vastly increasing the efficiency of forest crop utilization. To dump sawmill wastes around mill sites and in streams or to incinerate is almost criminally wasteful.

These wastes can be classified generally as (1) Logging wastes, including stumps, tops, large limbs, culls and breakages; and (2) milling and fabricating wastes, such as slabs, sawdust, edgings, trims, shavings and turnings. It has been estimated that the Pacific Northwest has about one-quarter of the remaining saw timber in the United States.[3] Also it has been estimated that the annual logging and sawmill wastes total about 10 million tons each for Washington and Oregon alone, the so-called Douglas Fir region.[4, 5] According to the figures obtained by Allen H. Hogdson in his 1929 survey, a consolidated annual waste of 22,351,000 tons exists.

Friedrich Bergius told the Tercentenary Conference of Arts and Sciences at Cambridge (Aug. 31-Sept. 12, 1936) that 60-66 percent of soft wood can be hydrolyzed to sugars of which 80 percent can be fermented to alcohol. Using the Bergius process, 66 gal. of 100 percent alcohol could be recovered per ton of dry soft wood, or 69.5 gal. of 95 percent alcohol.[6] Therefore, in the Pacific Northwest the potential an-

Table II—Partial List of Byproducts Derivable From Sulphite Waste Liquor
(Basis: 1 ton air dry pulp except as noted)

	L. C. Haffner	Pulp Co.
Sulphite liquor, gal.	2,570†	1,900
Alcohol, 99 percent, per		
M gal. sulphite liquor, gal.	......	10
Per ton air dry pulp, lb.	4	....
Daily production, gal.	......	8,000+
Yearly production, gal.	......	2,800,000
Sugars, lb.	451	....
Methanol, lb.	23	....
Ethanol, lb.	4	....
Acetone, lb.	3	....
Acetic acid, lb.	18	....
Formic acid, lb.	104	....
Furfural, lb.	6	....

† Sulphite liquor: 10.7 percent solids; sugars 16.91 percent of solids.

(*Please turn to page* 121)

* Conversion factors for 95 percent alcohol are: sp. gr. at 60 deg. F., 0.8161; lb. per gal., 6.794.

Town of Green River, Wyo.; region is typical of area in which proposed industry would be established

Possibilities for a Wyoming Chemical Industry

Chem. & Met. INTERPRETATION

Two important chemical industry raw materials, trona and wyomingite, occur in large quantities near Green River, Wyo., while limestone, phosphate rock, sulphuric acid and cheap fuels are available nearby. A proposal has been made by Robert D. Pike, consulting chemical engineer of Pittsburgh, that these deposits be exploited in the manufacture of crude calcined trona, refined soda ash, potash salts such as the carbonate and hydroxide, and phosphates such as TSPP and TSP. The following brief summary is based on a statement made by Mr. Pike before the Senate Subcommittee on Public Lands, presented on July 23, 1941.—*Editors.*

A PROPOSAL which has been advanced to assure the availability of large quantities of a high-grade crude soda ash, for tremendously expanded metallurgical requirements, was made by Robert D. Pike, consulting chemical engineer of Pittsburgh, in a recent statement before the Senate Subcommittee on Public Lands. Mr. Pike believes that development in the near future of the natural resources of the Green River, Wyo., area would not only provide the required soda ash, quickly and at low cost, but would permit establishment of a permanent industry for the manufacture of soda, potash and phosphate compounds, capable of absorbing shipping expense to the Mississippi Valley, or even farther east. The summary given here is based on Mr. Pike's statement, and on a more detailed report prepared by him.

The deposits of Wyoming leucite occurring in the Zirkel Mesa at Superior, Wyo., have long been recognized as unique in the United States. This mineral, wyomingite, is a potassium aluminum silicate, containing 11.48 percent K_2O, with comparatively small percentages of iron, calcium, magnesium and phosphorus oxides. The Zirkel Mesa deposits can be mined by open quarrying, without overburden, and have been estimated to amount to fully 1 billion tons.

Also known for many years have been the soda brine wells at Green River, the water of which contains in the neighborhood of 9 percent Na_2CO_3, a little NaCl, and minor quantities of other salts. Unsuccessful attempts were made about 35 years ago to exploit these brines on a large scale, for caustic soda manufacture. Currently they are being used on a small scale for making sal soda. Only recently the source of the brines has been discovered in the existence of a tremendous bed of massive trona, occurring about 20 miles west of Green River. Trona was first discovered in 1939 in a test hole put down by Mountain Fuel Supply Co. The discovery was brought to the attention of the Union Pacific Railroad by Mr. Pike and in 1940 the railroad sank two additional test holes, confirming the existence of the mineral. The deposit, evidently ranging from 15 to 20 ft. in thickness at a depth from 1,500 to 1,600 ft., has been estimated to be of large extent, possibly totaling as much as 7 billion tons. It consists of nearly pure trona ($Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$) containing about 47 percent Na_2CO_3 and about 36 percent $NaHCO_3$, plus 17 percent water. Impurities are present in small amounts, including an organic discoloration which is readily removed from the product during refining.

Also available near Green River are large supplies of 920 B.t.u. natural gas and sub-bituminous coal. Accessible to railroads within a radius of about 200 miles are byproduct sulphuric acid, phosphate rock, and limestone.

Briefly, the proposal is that the trona deposits be opened up by a shaft mine, and room-and-pillar system of mining, permitting trona production at an estimated cost of \$1.50 per ton. Presumably, the trona would be hauled to a point nearer to the town of Green River where a plant would be established for refining a high purity soda ash, and producing a calcined crude product containing 99 plus percent Na_2CO_3; and for the manufacture of other chemicals based on trona, wyomingite, limestone, byproduct sulphuric acid and phosphate rock.

The primary products of the pro-

posed industry would be crude and refined soda ash. Economy in shipment of the crude material requires calcining in order to eliminate the water of crystallization and the excess CO_2 of the bicarbonate. Such calcining results in a loss in weight of about 30 percent. For the production of refined soda ash, the proposed process contemplates dissolving coarsely crushed mine-run trona in water at 85 deg. C., settling and filtering to remove shale and other solid suspended matter, and treatment with a small percentage of activated carbon for complete removal of the organic coloring matter. The clear liquor is then cooled in an eight-stage vacuum crystallizer equipped with mother-liquor-cooled surface condensers in the first four stages and water-cooled barometric condensers in the last four. The crystal slurry goes to a thickener and filter, and the mother liquor is recycled. Carbon dioxide lost in the first four crystallation stages is collected and used to recarbonate the recycling mother liquor. The recovered crystals of pure sodium sesqui-carbonate (trona) go to an open-flame calciner for production of pure soda ash.

Owing to the availability of trona as an extremely cheap sodium carbonate at such a plant, the next proposal is to utilize wyomingite in the production of potassium carbonate by an interesting base-exchange process known as the Lemberg reaction. In this reaction the leucite content of the wyomingite ($K_2O.Al_2O_3.4SiO_2$) is treated with a sodium salt such as NaCl or Na_2CO_3, with exchange of bases between the sodium salt and the leucite. The silicate portion of the radical does not take part in the reaction. Using trona as the sodium salt, the process yields potassium carbonate, byproduct sodium carbonate, and a sodium aluminum silicate tailing. The yield is said to be 8 lb. of K_2O per 100 lb. of wyomingite.

The process consists in treating crushed trona and 20 mesh wyomingite with water in a rotating steel autoclave, first under 30 lb. steam pressure to break the trona down to sodium carbonate, then under 200 lb. steam pressure for two to three hours to complete the base-exchange reaction. The resulting slurry is cooled, filtered and washed, the solids discarded and the filtrate and washings concentrated in a quadruple-effect evaporator. Byproduct sodium carbonate monohydrate crystals come off the second effect while a double salt, $NaKCO_3$, crystallizes in the last effect, to be recycled. The concentrated solution from the last effect is cooled to 25 deg. C. in a crystallizer, the resulting slurry centrifuged, the mother liquor recycled and the crystals of $K_2CO_3.3/2\ H_2O$ dried.

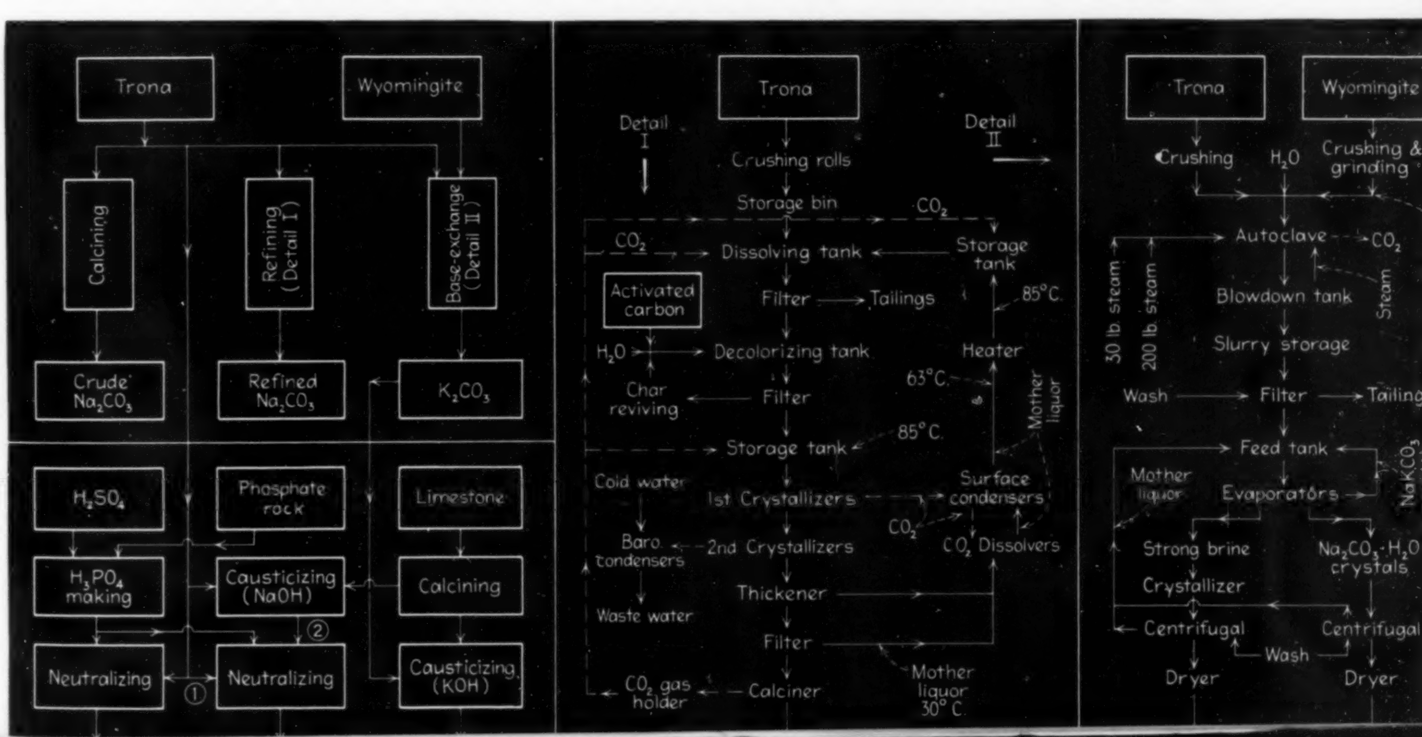
It is suggested that the proposed industry would have a marked advantage in the production of potassium carbonate and hydroxide, since the former is a primary product, produced without need to carbonate electrolytically produced KOH, while the latter can readily be made from K_2CO_3 by causticizing with lime.

The third phase of the proposed Green River operations contemplates bringing phosphate rock from Conda, Idaho, and byproduct sulphuric acid from Garfield, Utah. Manufacture of phosphoric acid by the Dorr strong-acid process would produce an acid of 45 percent P_2O_5. This acid would be neutralized with trona to produce dibasic orthophosphate solution which would be decolorized with char, filtered and cooled to produce $Na_2HPO_4.12H_2O$ crystals. These, on calcining, would yield anhydrous tetrasodium pyrophosphate, $Na_4P_2O_7$. Alternately, other sodium phosphates could be manufactured, including trisodium phosphate which would be made by neutralizing phosphoric acid, first with trona (to produce the dibasic salt), then with NaOH to produce the tribasic salt.

One reason why this Wyoming trona deposit should be opened up in the near future, according to the report, is an impending shortage in the supply of soda ash for use in the production of alumina for aluminum manufacture. A possible new use of considerable size and interest is in steel making. It has been authoritatively suggested that blast furnace operation can be speeded up 15-20 percent through less desulphurization in the furnace, followed by the use of 20 lb of soda ash per ton of iron in the ladle to complete desulphurization.

The report proposes annual production of 200,000 tons of crude soda ash, 114,000 tons of refined soda ash, 14,800 tons of calcined potassium carbonate, 15,750 tons of tetrasodium pyrophosphate, and 45,000 tons of trisodium phosphate.

Consolidated flowsheet with details of trona refining and potassium carbonate processes at right



Several of the cyclones and classifiers used at the Dicalite plant

Products from

PAUL D. V. MANNING

Pacific Coast Editor, Chemical & Metallurgical Engineering

Chem. & Met. INTERPRETATION

In Central Oregon there is a 1,000-acre deposit of diatomaceous earth which has been known for many years. In 1933 it was taken over by the Dicalite Co. In 1940 the plant was completely rebuilt following distruction by fire and many new processing improvements were incorporated. The 40-ft. deposit is unique in that it is of fresh-water origin and the diatoms are of an elongated type especially suitable for processing into high flow-rate filter aids.—*Editors.*

Chemical and mining engineers, especially the latter, grow accustomed to receiving samples of diatomaceous earth and descriptions of deposits from enthusiastic and amateur prospectors. This material has been plentifully distributed throughout most of the world but relatively few of such properties are found to be made up of the type of diatoms which can be used in the process industries.

Diatomaceous earth is made up of the silicious skeletons of microscopic plants which in natural habitat, grew beneath the surface of water, usually on the bottom of a body of water. This in part accounts for their wide distribution. Certain types of these skeletal materials, when properly processed, are exceedingly useful to the chemical industry, principally as filter aids and as heat insulating materials. To be useful in filtration, the microscopic particles making up diatomaceous filter aids must form a "screen" of very minute openings or "pores." These pores are formed by spaces around and between the treated diatoms which of themselves do not seem to be porous. Viewed under the microscope these small particles show indentations but no pores. Hence, best results in filtration will be obtained by those materials that will form a kind of "strawpile" on the filter cloth, but which at the same time will show the least resistance to liquid flow.

Since all diatomaceous deposits are highly absorptive, the raw material is usually very high in moisture and the practical diatom prospector has learned that deposits low in moisture are of little or no practical value. The diatoms must therefore have physical properties which enable them to withstand processing without loss of their desirable features.

Other uses for the finished products include their use as fillers for plastic rubber, paper, polishes, asphalt; admixed with concrete, inert extenders and flatting agents for paints, etc. Each of these uses requires certain characteristics which are gained by raw material selection and processing. From this it is easy to understand why all diatomaceous earth deposits are not suitable for commercial purposes.

In Central Oregon, about 15 miles east of Redmond and close to the Deschutes River, at Terrebonne, is a deposit which has attracted attention since about 1910. It was worked rather sporadically up until 1933 when it was taken over by the Dicalite interests who were already operating properties in the Palos Verdes Hills near Los Angeles. (*Chem. & Met.*, Jan. 1938, p. 28.)

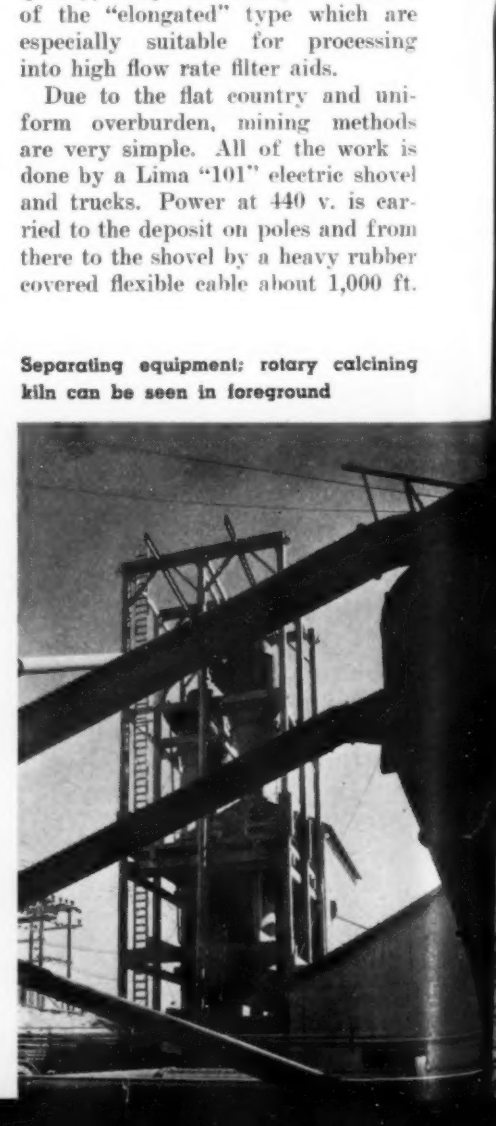
In 1940, the plant was completely destroyed by fire and has recently been rebuilt with the incorporation of new improvements in processing.

A comparison of the two raw materials is quite interesting. The diatoms making up Palos Verdes deposits are mainly of the spicular type and the deposit is as usual, of marine or salt water origin. The Oregon deposit on the other hand is of fresh water origin, and so far as is known by this writer, is the largest and only commercially significant of such fresh water deposits.

Possibly it was formed by a lake which covered the flat land, dammed by a lava flow, for the whole surrounding country is of the volcanic type. Beneath the 10 to 12 ft. overburden of sand and gravel, the deposit itself is 40 ft. thick and is nonstratified, covering over 1,000 acres. The crude "ore" is of very high quality, composed mainly of diatoms of the "elongated" type which are especially suitable for processing into high flow rate filter aids.

Due to the flat country and uniform overburden, mining methods are very simple. All of the work is done by a Lima "101" electric shovel and trucks. Power at 440 v. is carried to the deposit on poles and from there to the shovel by a heavy rubber covered flexible cable about 1,000 ft.

Separating equipment; rotary calcining kiln can be seen in foreground



Diatoms

in length. This cable rests on the surface of the ground. The shovel is mounted on its own "cat"-type tractor and moves where needed.

A gasoline shovel used in the early days was discarded in favor of one electrically operated which avoids cold weather starting difficulties.

Once mined, the crude ore is carried by truck either to the stock pile to allow some air drying or directly to the crude bins.

The crude material is broken with as little damage as possible to about walnut size by means of large, slowly revolving so-called "spike rolls." The spikes are very rounded protuberances on the roll surfaces and the rolls are not set close together. This is to avoid damage to the diatom structures.

A long inclined Link-Belt conveyor carries the disentegrated material to the top of two large storage bins made of laminated two-inch by eight-inch wood of 90 ton capacity. The material feeds out of the bottom of the bins and into the process which varies according to the requirements of the finished product being made.

Three main classes of products are produced. These are, first, the natural products which are dried and milled and air classified to standard specifications. These products are greyish white in color. The second class is that produced by drying, then calcining at temperatures up to 1,900 deg. F. in a rotary kiln. Complete automatic control is effected by Brown instruments. Oil is used for fuel. The products from this operation are pinkish or buff in color. The third type is the "white processed" material. The process is approximately the same as that used in making the calcined product, but a chemical treatment precedes the calcination.

In any process for manufacturing diatomaceous earth products the important essentials are to obtain uniformity of treatment, separation of individual particles, and classification, without injury to the diatom structures. Since the process must be carried out by the use of air, the proper selection of fan types and speeds is important. In handling such exceedingly light materials, special types of traps and cyclones have been developed with consideration to velocity of air flows to reduce to a minimum destruction of diatom forms.

Milling operations are carried out in "fan mills" so designed as to break up agglomerates without breaking up individual diatoms. These special fans also move the air in which the product is suspended.

Except for minor details, the process is somewhat the same as used in the Palos Verdes plant. An improved cyclone separator has been developed and this is shown in the accompanying illustrations. These cyclone separators permit a more accurate control and efficient classification of the material removed, the proportion of material skimmed from the flow stream being carefully controlled.

Looking down on the Dracco filter in the baghouse of the Terrebonne plant

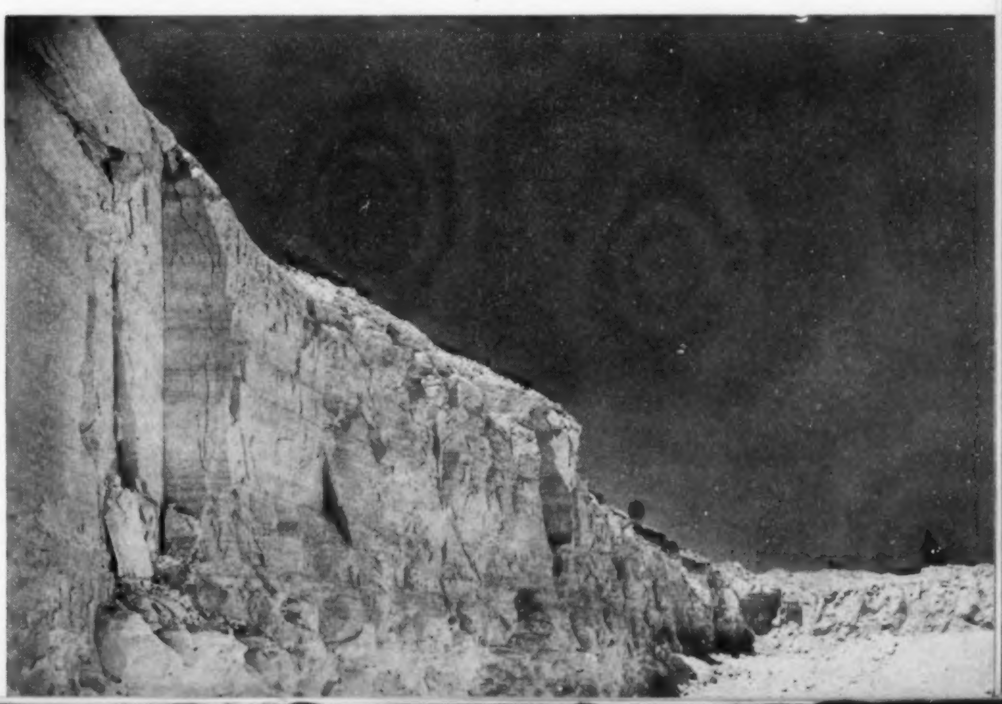
Newly installed bag filter equipment is of the "Dracco" type, bag shaking in each cell being carried out automatically in a timed schedule. The products are packed by St. Regis tube packers in four-ply valve type, paper bags.

A well designed and well staffed laboratory provides control of the process and checking of the product.

We acknowledge appreciation to A. L. Gossman and McKinley Stockton for the courtesies extended to us in visiting this plant.

Power shovel quarrying crude "rock" at the Terrebonne, Ore., deposit

Wall of diatomaceous silica which shows how the deposit was laid down. Exceptionally free from impurities, the Dicalite engineers call it "beautiful stuff"



Opportunities for Chemical

FRANCIS J. WEISS *National Planning Association, Washington, D. C.*

Chem. & Met. INTERPRETATION

Through mining, fishing, and forestry, Alaska offers interesting opportunities for chemical industries, both within the Territory itself and as a source of raw materials for Pacific Northwest process industries. The author, an expert in both chemistry and economics, suggests the possibilities which engineers and executives of chemical process industries should seriously consider for present as well as for future development.—*Editors.*

Though Alaska offers many raw materials for the manufacture of chemical products, some of which are indispensable for consumers' goods or military requirements, what should be appreciated more at the present is her capacity to furnish certain materials which the United States must import. Of the 14 "strategic" materials, 9 are found in Alaska, namely antimony, chromium, manganese, mercury, mica, nickel, quartz, tin, and tungsten, while of 15 "critical" materials eight are found in Alaskan resources, namely bauxite, asbestos, graphite, hides, iodine, platinum, tanning materials, and wool.

Some Alaskan mineral deposits have not been surveyed because of their inaccessibility, others cannot be mined, concentrated, and transported until sufficient machinery has been installed, while others are located in such harsh regions that getting labor would be difficult and costly. Given sufficient time to develop its potential 2,800,000 hp. of hydroelectric energy and to build transportation facilities, plants and workers' houses, there is no question but that Alaska, in spite of its relative remoteness from the market, might become a suitable location for some of the basic chemical industries.

Alaska is the natural hinterland whence most of the raw materials for the expanding industries of the Pacific Northwest can be procured. Therefore, if we speak about "chemical possibilities in Alaska" these are to be understood as comprising smaller enterprises within the Territory where chemical products are to be manufactured, and larger ones where primary products are to be extracted for subsequent chemical processing in the United States.

MINING INDUSTRIES

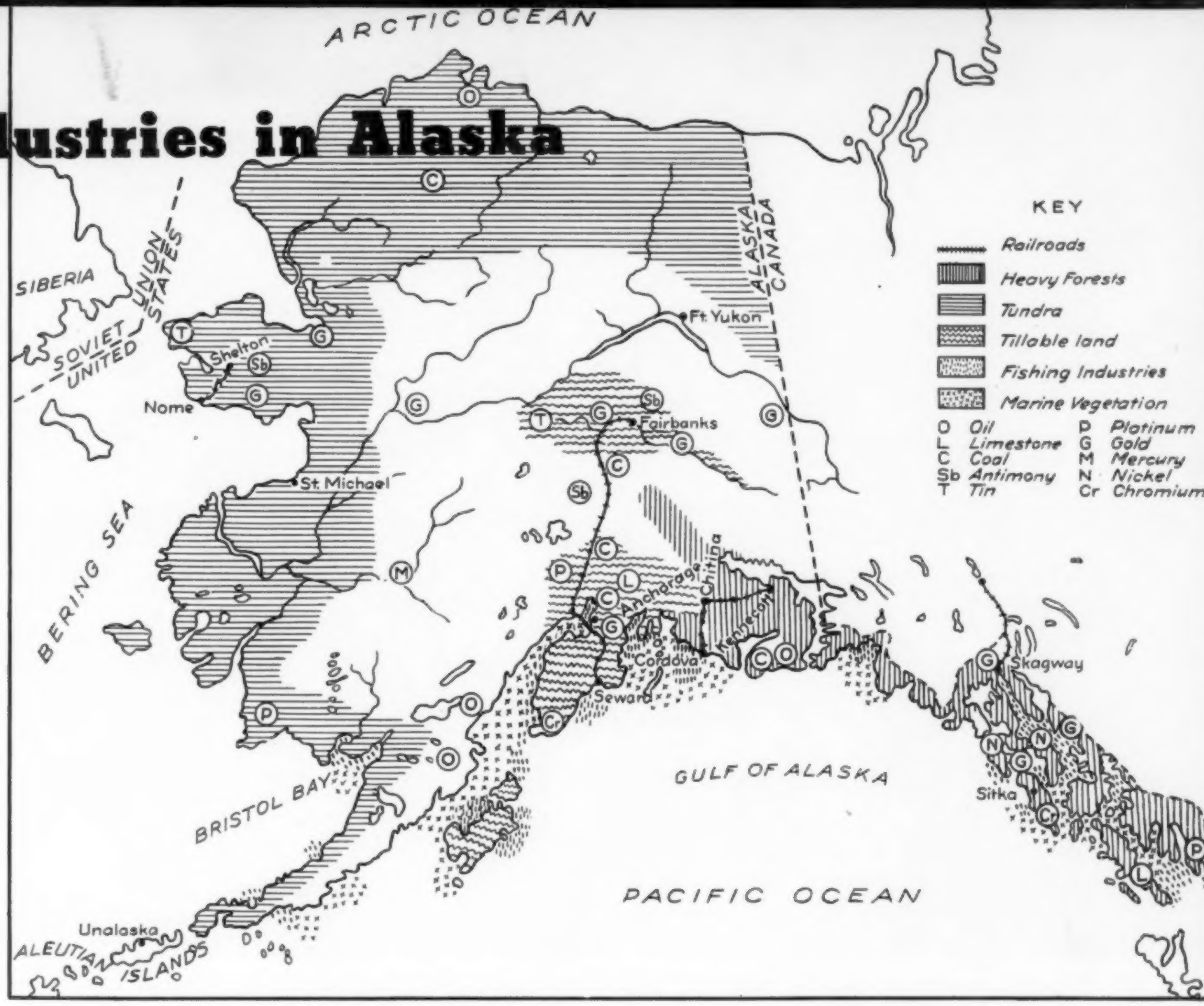
It is difficult to overestimate the importance of the mining industry to the general welfare and development of the Territory. Minerals produced from Alaska mines in 1940 had an estimated value of $27,658,000,[1] which brings the total mineral output since 1880 to more than $830,000,000. Though the production of gold ranks first with $25,375,000 or 91.8 percent, other mining products are more valuable to the chemical industry. The greater part of the platinum metals comes from mines near the mouth of the Kuskokwim River in southwestern Alaska in the Goodnews district.[2] Others, mainly palladium, are recovered as by-products from gold and copper ores. These are being developed on Kasaan Peninsula in the Ketchikan district and at Koyuk in the Seward Peninsula. The output of platinum metals in 1940 showed a considerable increase over 1939, amounting to 28,860 fine ounces valued at $1,092,000, thus placing Alaska among the five largest platinum producing countries in the world.

Another metal from Alaska is silver, of which about 198,000 ounces valued at $141,000 were produced in 1940. Lead is recovered entirely as a by-product from ores mined for their gold content and although the lead in each ton of these ores is only a few ounces, the large tonnages treated in 1940 yielded 1,920,000 pounds of lead worth $96,000.

Of greatest potential strategic importance are Alaska's tin deposits, since only 0.2 percent of United States peace-time demand of this metal can be supplied from domestic sources. The output of tin in the western part of Seward Peninsula in 1940 showed an increase of approximately 25 percent over 1939, which was 92,200 pounds valued at $46,000. Investigations of two areas where tin minerals occur are now under way by the U. S. Geological Survey. One is near York in the Seward Peninsula,[2] the other in the Hot Springs district where tin ores have been known for a long time. Tin ores

Members of the Geological Survey in Alaska in 1940. The Survey is continuing its valuable work on the discovery and evaluation of tin, chromium, tungsten and other mineral deposits of the Territory

Industries in Alaska



Alaska, with an area one-fifth that of the continental United States, has many raw materials for chemical industries, including mineral deposits, marine vegetation, forest products, coal and limestone

mined in the Seward Peninsula were formerly shipped to Singapore to be smelted and refined and from there back to the United States. Now they will probably be processed in smelters to be built in the United States.

Production of antimony ores showed a marked increase during 1940. All shipments came from a single mine in the Kantishna district in the north of the Alaska Range. A significant development in Alaska's mineral industry during 1940 was the opening up of a quicksilver[4] mine in the Kuskokwim Valley near Sleitmut. Nickel deposits have been known for a long time in Alaska and these are now being examined as a continuation of investigations that disclosed the existence of nickel-bearing minerals in Chichagof Island.[5] Deposits of chromite are known to occur at a number of places, and from one mine considerable ore was shipped some years ago. This is near Seldovia on the southern tip of the Kenai Peninsula[6] where new operations were started last year. Another deposit is at Red Bluff Bay on the east coast of Baranof Island. Both are being examined by the U. S. Geological Survey. The chromite deposits of Kenai Peninsula are estimated at 150,000 tons of which about 70,000 tons are of shipping grade, while the remainder is contained in some 170,000 tons of lower-grade ore which requires concentration to produce a marketable product.

COAL OUTPUT

Coal, the most important of nonmetallic mineral products of Alaska,[7] had an output in 1940 of 170,000 short tons valued at $680,000. This was the greatest quantity ever mined in the Territory. By far the largest part comes from the Healy River field and consists of a high-grade lignite used for generating power in the Fairbanks district and for commercial and domestic purposes in Central Alaska. The other mine is located in the Matanuska field and yields bituminous coal used as a fuel for the Alaska Railroad and also for commercial and domestic purposes in central Alaska.

During the period 1880-1915, of the total Alaskan coal consumption of 1,831,212 short tons, only 71,633 short tons was of local production, while in 1939 the consumption of 172,597 short tons included 146,250 short tons from Alaska. Though figures for 1940 are not yet available, it can be assumed that Alaska has already reached self-sufficiency in coal and will be able to maintain this during a period of industrial expansion.

High-grade limestone is quarried on Dall Island in the Ketchikan district and is shipped to Seattle to be converted into cement. Water power and bituminous coal near limestone deposits offer prospects for future development, particularly since this region will probably become a center of the wood pulp and cellulose industries, large consumers of certain basic heavy chemicals.

Unexploited known deposits of other minerals include molybdenum,

Courtesy Pacific Aerial Surveys

Fairbanks, located in the heart of Alaska, has good rail and highway connections to the southern coastal regions. This view, which shows the University of Alaska in the distance, was taken during the month of August at 2:30 a. m.

tungsten, barite, graphite, gypsum, and sulphur, all of potential value. However, their exploitation must be postponed until a more intensive development of the Territory labor, traffic, power and market conditions becomes more favorable. Nor is any use now made of 109 hot and mineral springs[8] of the Territory that, apart from their medicinal and recreational significance, offer interesting industrial possibilities.

MARINE PRODUCTS

Alaska's greatest wealth lies not in its soil but in the sea. While the area of Alaska, about 590,000 square miles, is nearly one-fifth that of the continental United States, the length of its coast is 15,132 miles as compared with only 9,626 miles for the latter. No wonder that fishing and fish canning is the most important source of income in Alaska. The total value of aquatic products produced from 1880-1940 was $1,270,000,000, exceeding by one-half the value of mineral products in the same period. Of this amount more than 90 percent represents the value of salmon products alone.

Considerable parts of the fish pack are being wasted or deteriorate by the combined action of light, oxygen from the air and fermentation and it is fair to state that from an average of 500 million pounds of salmon caught annually some 30 percent becomes waste at the cannery. This waste could yield 15-30 gal. of oil per ton, making a potential production of salmon oil of about 1,000,000 gal.[9] The present output is only about 70,000 gal. valued at about $20,000. Even this is only of technical grade for use in the soap, paint, varnish, and oil-cloth industries. Its most valuable constituents, vitamins A and D, are lost or destroyed by the destructive action of peroxides of unsaturated fatty acids. Therefore, to preserve the wasted vitamins and also to improve the quality of other fish products, peroxide formation must be eliminated and the material protected from light. The latter does not offer serious obstacles, and the former has been solved by the use of anti-oxidants. These, already being applied on a commercial scale by some Atlantic fisheries,[10] offer possibilities in the Pacific, particularly in Alaska.

Apart from its use as a possible raw material for vitamins, fish oil has entered into more and more chemical processes in the manufacture of a variety of goods. Though new chemical methods can produce a high quality and unobjectionable product, low-grade fish oils are still the rule rather than the exception. The fortification of vegetable oils and fats, the production of high quality soaps, the manufacture of manganese, cobalt and lead soaps as "driers" for paints and varnishes, the production of aluminum soap for waterproofing textiles and of copper and mercury soaps for anti-fouling paints for ship bottoms: these all offer opportunities for better utilization of fish oil. Another field of application for fish oil, particularly fit for Alaska, is in the leather industry where "chamois tanning" of sheep, goat and reindeer hides seems to be preferable to other methods. Another opportunity is as a lubricating

agent, particularly in steel cutting.

When fish oil is pressed, a solid residue of meal remains, the composition of which varies with the species of fish and the process of manufacture. Herring meal, for instance, contains 70 percent protein, 12 percent fat, and 10 percent calcium phosphate, the rest being mainly water. In addition to its high feeding value, already being used extensively, it compares favorably in chemical composition with cheese and other materials. The fermentation of pure fish meal offers an entirely new chemical use for this relatively cheap raw material.

SEA WEED UTILIZATION

Though marine plants contain many useful substances, only occasionally have these been utilized by the chemical industry. In World War I the Department of Agriculture erected an experimental station at Summerland, Calif. to treat 100 tons of fresh seaweed per day. The dried weed was carbonized and the charcoal extracted for soluble salts, of which iodine was particularly valuable.[12] At the same time the Hercules Powder Co., in order to meet requirements for acetone and other organic solvents for the manufacture of smokeless powder, carried out the fermentation of seaweed at a plant in San Diego, Calif. When the war ended the plant at San Diego was dismantled. The present emergency suggests the possibility of establishing similar plants in the midst of the larger and denser seaweed growth at certain points along the Alaskan coast. Fermentation would be more suitable for Alaskan conditions than carbonization since the former does not involve previous drying (particularly uneconomical in a very humid atmosphere) or the installation of carbonization retorts. New methods of by-product recovery such as recently patented by the Dow Chemical Co. (U. S. Patent 2,144,-119) would possibly make the process more economical.

One of the products usually destroyed in the processing of sea weed is algin, which can be recovered by soaking the weed in one percent soda ash solution, separating the viscous liquid by filtering through a cloth and then precipitating the algin with dilute acids. This simple process yields a substance of astonishing chemical versatility and industrial application. Algin is easily soluble in water to give a colloidal solution so viscous that a two percent solution is as thick as a 50 percent gum arabic solution (which it can replace in many ways). When dried at 100 deg. C. it is capable of absorbing 300 times its weight of water and still remain insoluble. It is, therefore, not surprising that algin finds application in so many different fields, some of which are of strategic importance. The various mineral salts of alginic acid show the same chemical versatility as the pure acid. For example, (1) alkali alginates can be spun into non-flammable fibers; (2) ammonium alginate becomes insoluble upon drying and can be used in waterproofing fabrics, paints, varnishes, etc.; (3) iron alginate is an excellent styptic for medical and surgical field service; (4) heavy-metal alginates can be used as fungicides.

Yet these are not the most valuable uses that can be made of marine vegetation. Six years ago it was pointed out[13] that marine algae are the richest source of vitamins and organic mineral salts to make up deficiencies in nutrition. Chemical analyses are now under way to determine the content of vitamins A, B, C, D, and probably E, in 2,500 species of marine algae recently collected in the Pacific. About half a year ago the Germans started large operations to collect and utilize sea weed from the coast of Norway. It is reported that already two bakeries have been erected to make "bread" out of dried, ground and de-salted algae. Though this may be an emergency measure to cope with an acute shortage of flour, it may well be the beginning of a new industry, not to replace bread, but to supply deficiencies in our diet.

While the total mineral content of land-grown food averages two percent, the total mineral content of sea vegetation averages 25-40 percent of the ash constituents of the edible portion. Thus a possible way to restore and then to maintain a sound mineral balance in our bodies lies in the intake of selected marine algae or products therefrom. Commercial manufacture of mineralized foods from the sea vegetation in Alaska is already an established fact.

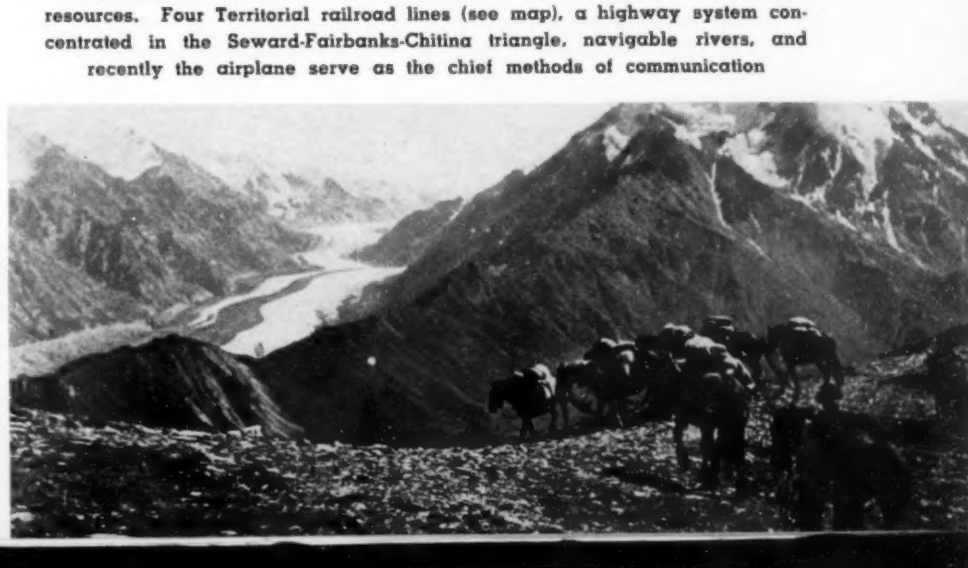
FOREST PRODUCTS

Large coastal and interior forests form the third greatest asset of the Territory. The coastal forests have been largely included in the Tongass National Forest of 16,546,000 acres and the Chugach National Forest of 4,800,000 acres. There is no question but that these forests (with an estimated stand of 85 billion board feet of commercial timber) have a future in the pulp and paper industry. Both the main constituents, Sitka spruce and Western hemlock, are excellent pulping woods. Their rapid growth insures a perpetual source of raw material, 1,000,000 hp. of hydroelectric energy is conveniently located, and excellent shipping prospects are offered by year-round water transportation for the logs to the mill and from the mill to the market.

Sitka spruce is highly appreciated because of its mechanical properties. A high ratio of strength to weight, toughness of fibers, and clear stock in suitable size make it especially fit for aircraft production.[14] The Timm Aircraft Corp. in California uses thin spruce sheets together with resin plastics of the formaldehyde type to construct airplanes of an oil-, water-, and fire-proof material that is 25 percent lighter than metal.[15]

Chemical utilization of Alaska's forest resources could result from the manufacture of "artificial wood" for wall and insulating boards to be used in Alaska for military and other purposes. Whether the Masonite or any other process should be applied to converting sawmill waste into profits

Transportation is still a major problem in the development of Alaskan resources. Four Territorial railroad lines (see map), a highway system concentrated in the Seward-Fairbanks-Chitina triangle, navigable rivers, and recently the airplane serve as the chief methods of communication



would depend upon the quality of the raw material and requirements of the finished product.

Another possibility would be the chemical preservation of wood logged in Alaska and needed for land and marine structures. Because of the humidity in southeastern and southern Alaska all wooden material used outdoors must be preserved against decay, while wood for marine purposes requires a special treatment against destruction by the shipworm. Wood preservation plants require little investment nor are operating costs such as to make competition with imported wood impossible. The ever-increasing market for preserved wood in Alaska would seem to make this chemical industry a promising enterprise.

TANNIN EXTRACTS

While 30 percent of the coastal forest is Sitka spruce, 69 percent consists of Western hemlock, the bark of which is the most efficient tanning material of domestic origin. Oak bark contains 24 percent tannin while the tannin content of hemlock is about 28 percent.[16] The leather industry of the United States consumes annually about 115,000 tons of tannin, equivalent to 460,000 tons of 25 percent extract, half of which must be imported.

Hemlock in this region amounts to 62 billion board feet, but the yearly cut is only 8 million board feet. But even the cut timber is not used for tannin recovery. For reasons of economy the wood is not peeled at the spot but is transported by waterways to the sawmills, thereby losing the tanning property of the bark which is leached out by water. For this reason the bark must be removed before the timber is transported. Should high labor cost make it uneconomical in Alaska, there are still ways to utilize tannin values of the bark, such as by truck logging and machine peeling.

In judging the prospects for a tannin or any other industry in Alaska we must always take into consideration the high labor costs. As a recent government report[17] states, Alaska suffers from a vicious economic cycle: underpopulation over a large area leads to high costs of transportation which in turn result in high living costs; high living costs cause high costs of production; the latter make most industries unprofitable while lack of employment causes underpopulation. However, this cycle is only the result of the fact that the United States has had so many resources that there was no need to develop Alaska's rich deposits. We now find ourselves in just the opposite situation. The defense program has required the establishment of military and naval bases in Alaska, which will greatly increase the population of the Territory. The necessity to provide the armed forces and the growing population with food, housing and other requirements is now stimulating industrial and agricultural activities as well as commerce and transportation.

Some 350,000 square miles of land in Alaska are not suited to any kind of agricultural activity except reindeer raising. While there are now about 300,000 reindeer in Alaska, the carrying capacity of these large stretches of tundra is about 4,000,000 head, the annual surplus of which would yield about 1,000,000 hides and 15,000,000 pounds of meat. Reindeer hides give the finest leather, while horns, bones, blood, and intestines are capable of being mechanically or chemically processed. However, the raising of so large a livestock requires a long time. But what can and should be done now is the milking of reindeer and the production of reindeer cheese, as this milk shows the highest content of solids (fat, sugar, albumen, minerals) of any of the mammals.

Though it must be admitted that in the present emergency only a few of the many chemical possibilities which the Territory has to offer will find realization, it should be stated that even these few will prosper only if well planned and carefully coordinated between each other as well as with the entire industrial activity of the continental United States.

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The city of Seward, which is surrounded by tillable land and located near the vast Alaskan fishing industry, is a possible center of new chemical industry. Other nearby potential raw materials include forest products, seaweed, coal and limestone as well as gold, platinum and antimony. A railroad connects Seward to Fairbanks and the center of Alaska, whereas the entire southern coastal region is easily accessible by water

ALCOHOL PRODUCTION

(*Continued from page* 111)

nual supply of alcohol realizable from 22,351,000 tons of waste wood would amount to 1,553,395,000 gal. of 95 percent alcohol annually (approximately 5,277,000 tons). On the basis of the percentages hydrolyzed and fermented, 50-52 percent of the original wood would remain for the manufacture of other byproducts.

The rival Scholler-Tornesch wood hydrolysis process reports 0.4 tons of fermentable sugar per ton of dry wood. This sugar is equivalent to 66.8 gal. of 95 percent alcohol per ton of dry wood. In addition, about 660 lb. of dry lignin per ton of dry wood remain as a possible byproduct.[7] By using this process the potential Pacific Northwest production would become 1,493,047,000 gal. of 95 percent alcohol annually, or 5,072,000 tons.

Since such a large quantity of alcohol is far beyond any normal market, only a relatively small portion of the total waste need be processed to secure both normal and emergency supplies, leaving all the remainder for development into hogged fuel, charcoal, and other useful products. It must be remembered also that, except for wastes already at the mills, the collection problem would be difficult and very costly.

These considerations rank wood waste sources of alcohol second to sulphite waste liquors in spite of the enormously greater amounts potentially available.

3. Fruit Canners' Rejects—Ernest H. Wiegand, professor of food products industries at Oregon State Agricultural Experiment Station, Corvallis, Ore., made the statement in 1937 that the waste from the canning of only the apples and pears from Hood River and Medford, Ore., and Yakima and Wenatchee, Wash., would have yielded an estimated 32,415 tons of sugar per year, equivalent to 6,426,666 gal. of absolute alcohol per year. Added to this would be 1,000,000 gal. more to account for the wastes from other fruits, a total of 7,426,666 gal. annually of absolute alcohol[8] (7,817,543 gal. of 95 percent alcohol, or 26,556 tons).

4. Beet Sugar Molasses—The three beet sugar refineries in the Pacific Northwest (at Bellingham and Toppenish, Wash., and Nyssa, Ore.) are producing an estimated 80,000 tons of refined sugar per year. With each ton of refined sugar produced, 800 lb. of molasses can be recovered as a byproduct,[9] making 32,000 tons of molasses available per year in the Pacific Northwest for fermentation to alcohol, if diverted from present markets. With molasses weighing 12 lb. per gal. and with 2.5 gal. required for each gallon of 95 percent alcohol produced, approximately 2,133,000 gal., or 7,250 tons of 95 percent alcohol would become available annually from this source.

The seven western states of Nebraska, Colorado, Wyoming, Montana, Idaho, Utah, and California produced 1,540,000 short tons of beet sugar in 1940.[10] On the same basis as above 407,733,000 gal. of alcohol could be available from this source, or 1,385,000 tons annually.

None of the molasses from the production of beet sugar in these western states is reportedly fermented for the manufacture of alcohol. Instead it goes principally into cattle foods.

5. Cull Idaho Potatoes—A small plant, capable of producing 720 proof gal. per day of alcohol (95 percent) is in operation in Idaho Falls, Idaho, but is at present producing far below capacity levels. It is part of the Agricultural Experiment Station, University of Idaho.

The yield of alcohol from the starch of potatoes is very close to 0.7 gal. of 95 percent alcohol per bushel of potatoes.[11] On the assumption that 10 percent of Idaho's 20 million bushel potato crop is cull, the potential annual alcohol yield from this source would be 1,400,000 gal. of 95 percent alcohol, or 4,756 tons.

6. Ethylene and Acetylene—The Portland Gas & Coke Co. and the Seattle Gas Co. are potential sources of ethylene which is the basis of one method of producing synthetic alcohol. The Pacific Carbide & Alloys Co., in Portland, Ore., is at present manufacturing calcium carbide from which acetylene, another basic material for synthetic alcohol, is produced. Electro Metallurgical Co. is building a plant in Portland, with CaC_2 as one of several products.

On the assumed basis of parity between the Portland and Seattle gas companies, and similar expansion plans, about 14,000,000 lb. of ethylene is potentially available annually in the Pacific Northwest, from which an estimated 20,916,000 lb. (10,458 tons) of absolute alcohol (11,008 tons of 95 percent alcohol) could be obtained (basis 90 percent conversion).

Ethyl alcohol can also be synthesized from acetylene. The acetylene is converted to acetaldehyde which is then hydrogenated. On the assumption that 90 percent yields can be achieved in the reactions, 147 tons of calcium carbide would be required daily in producing the 54 tons of acetylene needed to synthesize 100 tons of 95 percent ethyl alcohol.[12]

However, the numerous products possible from ethylene and acetylene synthesis are far too valuable to make desirable the use of either for alcohol synthesis.

Alcohol recovery from canners' wastes, cull potatoes and beet molasses would all be on a seasonal basis and consequently would involve more of a storage problem than the other sources. Alcohol picks up moisture and therefore must be protected from it in storage.

Conclusions—The Pacific Coast's annual production of about 19,000 tons of industrial alcohol cannot be diverted readily from present markets. In order to avoid serious dislocations of business, one or more of the potential sources discussed should be developed at the same time that plants are being built to bring in processes requiring quantities of alcohol.

The potential resources of the Pacific Northwest for industrial alcohol manufacture are enormous and only to be partially developed to meet any anticipated needs. The particular source used will depend upon the plant site chosen for the explosives plant or other plants requiring the alcohol.

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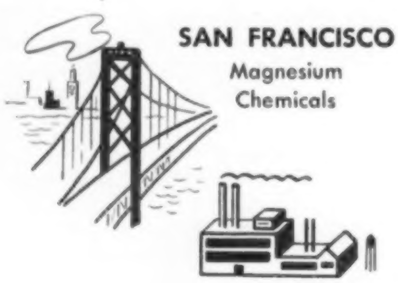
Products and Byproducts

Being a miscellany of more or less serious — mostly less — observations and comments on two weeks and 8,000 miles of travel and travail (?) in the 11 Western States by Chem. & Met's editor.

We had to go clear out to the West Coast to see—thoroughly at least—our first of the four new Regional Research Laboratories of the U. S. Department of Agriculture. The one at Philadelphia is so close to New York that our visit has been too easily postponed. Dr. Herrick showed us the outside of the New Orleans lab. during the A.I.Ch.E. meeting last December and we promised Dr. May that we'd visit Peoria as soon as Bob Zuppke gets a good football team at Illinois. But here we were at the Manning



Manse in Berkeley, a few miles from Albany, and we just had time to get there before Director Swenson was due at an important conference at a neighboring golf course.

The Western Regional Laboratory was certainly worth the visit. It's the last word in building construction, equipped with most modern laboratory and research facilities. Too bad so much of it is still empty and so much equipment still "on order." Nevertheless important work has already been started on utilization of cull fruits and crop surpluses. We saw plastics made from almost everything imaginable; sampled some wonderful jelly made from spray-dried apples and still made our date at the golf course!

On a previous trip we called on Dr. William B. McCallum, the eminent botanist who operates several thousand acres of guayule rubber farms and a breeding nursery, warehouse and pilot plant near Salinas, Calif. (see *Chem & Met.*, Vol. 38, pp. 128-132.) Now the wrinkled little scientist is back in the headlines as America's No. 1 rubber farmer. He has worked out a plan for forced cultivation that will produce 350 lb. of rubber per acre in eight months. This hurry-up rubber is expensive—costing 57 cents per lb. according to the good doctor, but at that it is cheaper than some synthetics. Given a stabilized price of 30 cents per lb. over a period of several years, he foresees guayule as a permanent crop in the Southwest, where, he says, 10,000,000 acres of marginal lands are suited for its production, yet only 4,000,000 acres would be necessary to take care of all our rubber requirements.

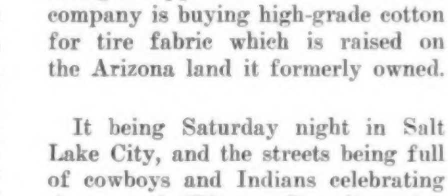
And so, on up the hot Sacramento Valley toward Portland. Had lunch at the capital of California's olive industry (sent post card to Ted), temperature just a little over 100 in the shade. Had dinner that night at the Inn in Crater Lake National Park, and could reach out and feel the snow on the mountainside. Don't talk to us about the extremes of Texas' climate!

Epso Lake is in North Central Washington, not far from the famous Soap Lake we investigated and poetically reported in September, 1938 (see Vol. 45, No. 9, p. 454). It gets its name from the fact that its saline waters will average about 50 percent by weight of magnesium sulphate. Since the area of the lake is about 12 acres and the average thickness of the salt cake is nearly 2 ft., it is apparent that Nature put a lot of epsom salts on this particular shelf of her medicine cabinet.

It is the business of the C. A. Kearney Co. of Tonasket, Wash., to get it out. This was formerly accomplished by pumping the most concentrated brine into a large solar evaporating pond where some 2,000 tons of crude epsom salts have already been deposited. Now the brine is hauled in a tank truck to the refinery in Tonasket, further concentrated by evaporation, filtered through sand and recrystalized. The wet crystals are centrifuged, dried in a rotary dryer, screened and sized before being packaged for the market in 100 lb., 5-ply paper bags. Recent production, as reported by *Mining World*, July 1941, pp. 29-31, was at the rate of about eight tons a day of the refined and sacked salts.

Driving from Tucson down to Nogales in Old Mexico, on a Sunday afternoon, just for the ride and a venison-wild boar dinner, we were shown miles of plantations where Arizona's famous long-fiber cotton is grown. But what interested us most was that much of this land, so we were told, once belonged to a certain large rubber company that had sunk several million dollars in an effort to raise sufficient guayule rubber to render this country independent of foreign supplies. Now the rubber company is buying high-grade cotton for tire fabric which is raised on the Arizona land it formerly owned.

It being Saturday night in Salt Lake City, and the streets being full of cowboys and Indians celebrating the annual "Pioneer Days," we betook ourselves again to Saltair for a bath in or on the buoyant waters of Great Salt Lake. At first we were disappointed to see that the old casino which back in 1924 we'd helped L. C. Karrick, then of the Bureau of Mines, save from fire, had finally burned down. Nevertheless we had so much fun, we almost missed the plane back to New York and did lose a lot of notes that might have made these pages more helpful and uplifting to chemical engineers. Even at that we had to pay $2.95 for 5 lb. of excess baggage we'd picked up some place in 8,000 miles of travel and travail.



SALT LAKE CITY
Research

P.S. We were ten minutes late for church the next day in New Jersey.

Machinery, Materials and Products

Chem & Met Process Equipment NEWS

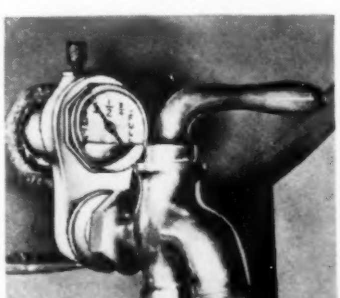
Rubber Troughing Idler

To ABSORB shock from the feeding of heavy, lumpy and rough materials at the loading point of a belt conveyor, Link-Belt Co., Indianapolis, Ind., has introduced a new rubber-tread impact idler of troughing type, as a companion to the rubber-tread return belt conveyor idler which was announced in our July 1941 issue. In absorbing shocks the new idler is said to increase the life of both belt and idler. Other advantages claimed include less breakage of fragile materials, resistance to corrosion and abrasion and an effect of cleaning the belt and preventing build-up of material. The molded rubber-tread rolls are 6 in. in diameter and are supported on a roller-bearing-equipped tube. Idlers are available in widths from 14 to 60 in. Larger diameter rolls can be supplied if desired, as well as rolls for flat-belt conveyors.

Drum Level Indicator

A SIMPLE level indicator for installation in standard 55-gal. steel drums used for storage has been developed by U.C. Level Indicator, 624 East Locust St., Milwaukee, Wis. The level indicator unit screws into the faucet opening of the drum and is threaded to receive any type of spigot or faucet using the standard type fitting. The amount of liquid in the drum is clearly indicated at all times. Although not calibrated to show actual content in gallons, the gage is designed to indicate whether the drum is full, empty or ¾, ½ or ¼ full.

Level indicator for storage drums

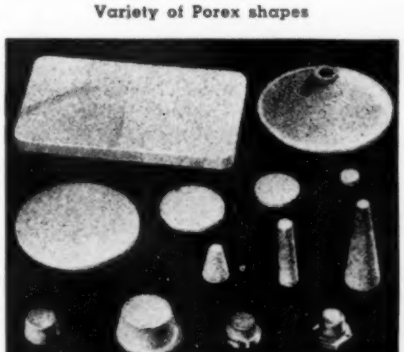


Porous Metal

POREX is the name of a new porous metal product for filtration and gas diffusion which has been introduced by the Moraine Products Division of General Motors Corp., Dayton, Ohio. This material is manufactured from powdered metal in a manner somewhat similar to powdered metal bearings. As shown in the accompanying illustration, Porex can be supplied in a variety of forms including plates, disks, cones, thimbles, cylinders and other shapes. It is being used for the filtration of liquids to remove small quantities of clogging solids, and as a diffusion medium for gases, for example, in retaining solid drying materials in gas-dryers. Another function is separating oil, moisture and solids from air.

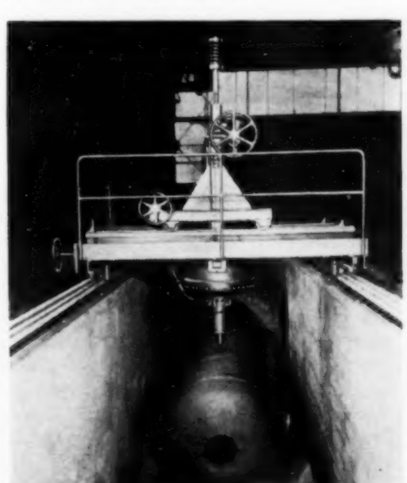
Porex can be produced in a wide range of physical characteristics and chemical compositions. The material may be bonded to steel or copper and can be made an integral part of solid metal which may be machined, ground or otherwise treated. Within limits, almost any size of molded object can be produced up to 12x24 in. in sheets, 12 in. diameter in disks, 3 in. diameter in cylinders, and 4 in. maximum height in cones.

Variety of Porex shapes



1,000,000-Volt X-Ray Machine Installed

Indicative of the trend toward the welding of much greater thicknesses of metal for pressure vessels is this new 1,000,000-volt X-ray machine recently installed at the Barberton, Ohio, plant of the Babcock & Wilcox Co. The machine, built by General Electric X-Ray Corp., is said to be one of the first of this high voltage to be installed for industrial use. It permits X-ray inspection of pressure vessels with thicknesses up to 8 in. and will inspect 1 ft. of weld in 4½ in. plate in 3 minutes, compared with 3½ hours for the 400,000-volt machine previously used. The machine is shockproof and self-contained and is supported on a specially constructed carriage over a pit in which the vessel to be X-rayed is placed. Controls are installed in a separate concrete-walled room, providing 36 in. of concrete for protection of the operator.

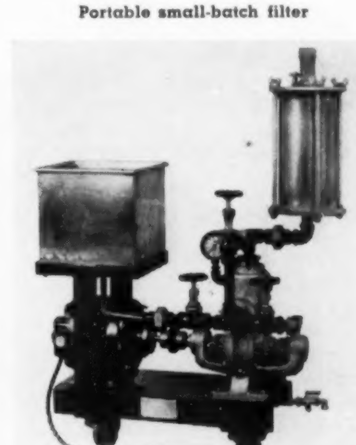


Small Batch Filter

AS AN ADDITION to its line of pressure filters, a small batch filter and transfer pump combination, known as the Champion model, has been announced by the LeVal Filter Co., Chicago, Ill. In filters made by this company, the filter medium is a filter aid of any suitable type, deposited on a porous synthetic stone backing said to offer rigid and corrosion-proof support for the filter aid, but to be extremely pervious to liquid flow. The filter stone backing is made in the form of either hollow reinforced disks or cylinders. In use the porous stone is first pre-coated with filter aid by passing a heavy suspension of the aid through the filter. Flow of the material to be filtered is then immediately switched to the filter, the liquid containing a small amount of filter aid in suspension. This procedure is said to assure a longer filtering cycle, through maintenance of a higher flow rate.

The new model, shown in the accompanying illustration, consists of a

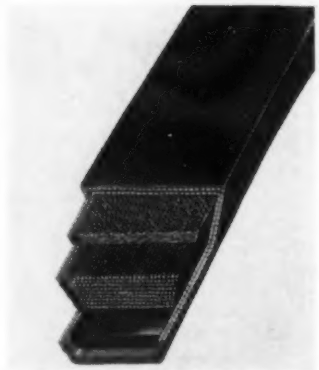
Portable small-batch filter



small all-bronze pump with bronze fittings, direct connected to a 1/6-hp. inclosed motor and mounted on a caster-supported platform. The pump will deliver up to 100 g.p.h. on water-thin liquids, and up to 2 g.p.m. against a discharge head of 10 ft. The filter chamber, mounted above the pump, has room for about 1 lb. of solids. A built-on 2-gal. tank is provided for precoating the filter stone backing. The filter unit may be readily removed to permit using the pumping unit for transfer work.

Improved V-Belt

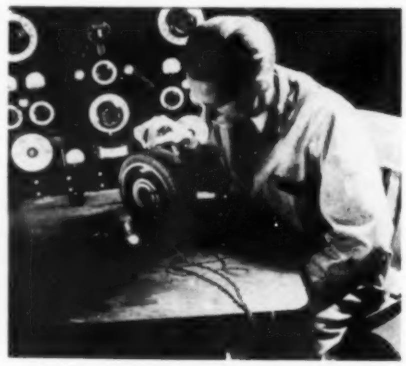
More strength and flexibility, greater service and longer life are claimed for the new "Super 7" laminated design now being employed by Allis-Chalmers Mfg. Co., Milwaukee, Wis., in all of its Texrope V-belts. The new design is said to be based on the Vogt formula and on abundant field experience. The cords of the belt are smaller, permitting the use of more cords per belt with resulting greater strength and less stretch. Each cord is individually imbedded in rubber. A live-rubber bottom cushion absorbs the impacts of operation. The central cord portion transmits power at the effective pitch diameter. Next comes a section of bias-cut fabric to prevent "dishing" and assure transverse stability. A two-ply rubber-impregnated fabric cover is provided to prevent destructive agents from reaching the vital belt elements.



"Super 7" V-belt section

Conducting Tires

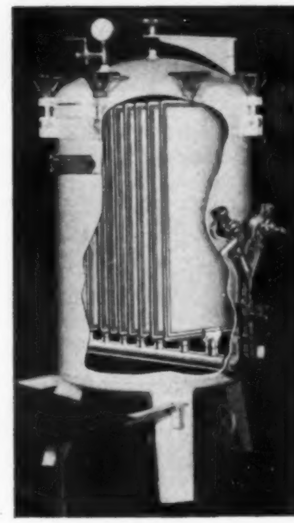
Industrial truck tires, manufactured from a special rubber compound said to have 1 million times the electrical conductivity of ordinary rubber, have been developed by the B. F. Goodrich Co., Akron, Ohio, for use in manufacturing plants where static electricity constitutes a fire and explosion hazard. This conductivity is said to be sufficient to prevent the accumulation of any charge of static electricity large enough to produce a spark. Known as Conductor Industrial Tires, they are available in a complete range of sizes and are said to be especially suitable for plants manufacturing explosives and flammable organic materials. The accompanying view shows a test of one of the new tires in which sufficient current was passed through the tire to light a neon bulb.



Test of conducting tire

Filter-Aid Filter

A new type of pressure leaf filter especially designed for use with filter aids, known as the Master-Aid filter, has been put on the market by Charles S. Jacobowitz Corp., 1432 Niagara St., Buffalo, N. Y. This filter is of the alluvial type, employing permanent metal screens on which filter aid is deposited to serve as the filter medium. Compared with plate-and-frame filters, the manufacturer claims various advantages including compactness of installation, easy cleaning and quick removal of spent cake by flushing. When necessary a completely inclosed system, including the filter aid feeder, can be supplied, as for example, where flammable, volatile or other hazardous materials are to be handled. Filter sizes range up to 10,000 g.p.h.



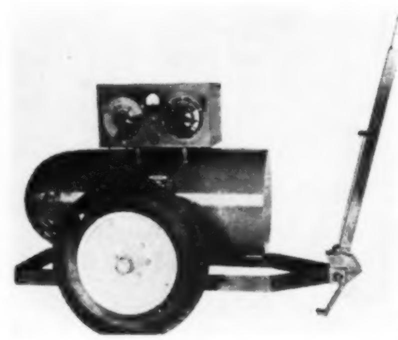
Pressure leaf filter

Sulphide Tester

A new outfit for accurate determination of total sulphides, dissolved sulphides and hydrogen sulphide in sludge, air and gases, has been announced by the LaMotte Chemical Products Co., Towson, Baltimore, Md. Known as the LaMotte-Pomeroy sulphide testing set, the outfit employs methods developed by Dr. Richard Pomeroy. All necessary apparatus is assembled in a wooden carrying case.

Welder Trailer

Designed for road towing at speeds up to 35 m.p.h., a new two-wheeled, light-weight, pneumatic-tired trailer for mounting arc welding machines has been announced by the Lincoln Electric Co., Cleveland, Ohio. The new trailer will mount this company's a.c. motor-driven welders in sizes from 200 to 600 amp. and also this company's 200 amp. special engine-driven welders. Mounting is readily accomplished by means of four bolts in the frame of the trailer which register with holes in lugs on the welding machine. As shown in the accompanying illustration, the combination tow bar and standing support has a hand-operated ratchet arrangement for locking the support arm in position. Standard 16x5.50-in. four-ply tires are used.



Arc welder mounted on trailer

Equipment Briefs

A novel development of the Tempil Corp., 132 West 22d St., New York, N. Y., is a line of thermometric pellets which are designed for temperature measurement. These pellets are stated to have a sharp, rapid melting action at the stated temperature. Types are made to melt at 25 deg. intervals from 125 deg. to 300 deg. F., and at 50 deg. intervals from 300 to 1,600 deg. F. The mean accuracy of temperature indication possible with these pellets is claimed to be within 1 percent of the stated temperature. Each Tempil is stamped with the temperature at which it melts. Furthermore, the pellets are made in distinguishing colors for each melting point. In use, a pellet is merely placed against the heated object, showing when it melts that the object has reached the stated temperature.

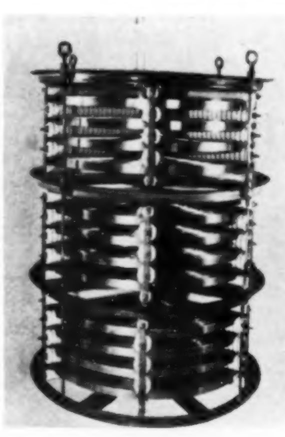
According to the Dake Engine Co., Grand Haven, Mich., many new uses for the company's engines have been

uncovered by the defense program. Since these engines operate on air pressure, requiring no electrical power, they may be used safely in hazardous locations to drive shaker screens, conveyors, vibrators, agitators and mixers in sizes from ½ to 30 hp. They have no dead center and are available in both reversing and non-reversing models. A number of recent improvements have been made, including development of a new outboard bearing type, with the outboard bearing integral with the engine. This, as well as other types manufactured, can be operated on steam instead of air if desired.

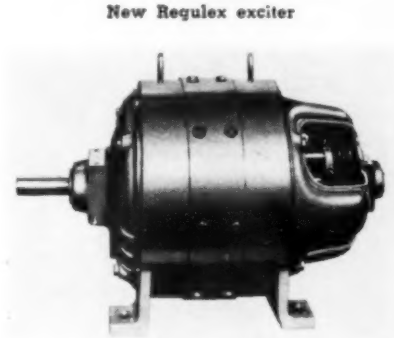
THE LINE of porous bronze bearings manufactured under the name of Self-lube by Keystone Carbon Co., 1935 State St., St. Marys, Pa., has recently been enlarged to include several new shapes and sizes. These bearings are made of powdered alloys which are molded to the desired shape, baked and finally quenched in oil. Their average porosity is 35 percent, often enabling the oil reserve to last the entire life of the application, according to the manufacturer. A tensile strength of over 35,000 lb. per sq. in. is claimed.

DOUBLE-ROLL crushers are usually manufactured with separate adjustment screws on each side of the machine frame for the adjustment of the crushing rolls. Since this method makes roll adjustment more or less of a time-consuming element, and introduces the possibility of uneven adjustment and worn bearings, McNally Pittsburg Mfg. Corp., 307 North Michigan Ave., Chicago, Ill., has developed a new and simple adjustment means for its 24-in. and 36-in. diameter stoker coal crushers. The two adjusting screws are provided with sprockets and connected together by a length of roller chain. To one adjusting screw a reversible ratchet lever is attached so that adjustments can be made simultaneously at both sides of the crusher.

Electric immersion heater



New Regulex exciter



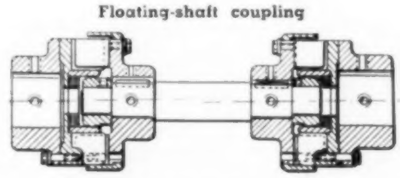
Combination Exciter

DEVELOPED especially for giving constant tension, as in paper machine drives, a new combination regulator and exciter in one unit has been announced under the name of "Regulex" by Allis-Chalmers Mfg. Co., Milwaukee, Wis. The unit is designed for automatically holding constant output on both d.c. and a.c. machines. It consists of a differential amplifier for controlling the excitation on d.c. motors and generators to give constant voltage, current, speed or tension. It is being developed for all sizes of d.c. machines and is applicable to a.c. synchronous motors, generators and condensers.

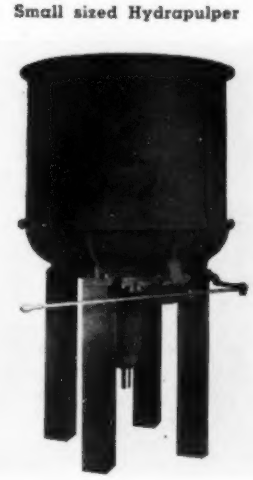
Immersion Heaters

FOR MAINTAINING and increasing temperatures of a wide range of materials, H. O. Swoboda, Inc., 118 Thirteenth St., New Brighton, Pa., has developed a new line of Falcon electric immersion-type booster heaters in capacities ranging from 10 to 1,000 kw. output. The heater consists of spirally coiled heater strips arranged in a compact unit and installed in a sealed tank which is built into the pipeline between storage tank and coating or processing vessel, thus acting as a booster to offset cooling in the line. Temperatures are maintained uniformly by means of automatic controls. Only two simple connections are necessary for connecting the heater to the electric circuit. Such heaters are applicable only with materials having electrical insulating properties, since in operation the bare electric coils are immersed in the material to be heated. Owing to this direct contact and to the large surface of the heating elements, the heater can operate at an extremely low watt density per unit of heat transfer surface, without appreciable temperature gradient between heater and material, thus preventing deterioration of the material.

Floating-shaft coupling



Small sized Hydrapulper



Floating Shaft Coupling

APPLICATION to either horizontal or vertical drives is possible with a new floating-shaft flexible coupling, designated as L-R Type HKQ, recently announced by the Lovejoy Flexible Coupling Co., 5009 West Lake St., Chicago, Ill. The new coupling is recommended for the longer distance drives, where the space between the driver and the driven units cannot be successfully handled by standard couplings; and especially where there is excessive misalignment. As shown in the accompanying drawing, the floating shaft is supported in fixed bearings which are entirely independent of the power transmitting element. They are thus unaffected by forces generated by the floating shaft itself and do nothing except transmit useful power. Concentricity of the ends of the fixed shaft is said to be permanently assured and whipping of the ends of the shaft eliminated at all speeds. The new coupling is made in shaft sizes of 1½ to 8½ in., for transmission of 7 to 800 hp. at 100 r.p.m. and for various distances between fixed shafts.

Small Capacity Pulper

DESIGNED especially for small capacity applications where an output of 10 tons in 24 hours is sufficient, Dilts Machine Works, Fulton, N. Y., announces a new Hydrapulper identical in every respect with large production units made by this company, except in size. This Hydrapulper has a 150-gal. capacity at operating depth, is 4 ft. in diameter and 10 ft. high. It is said to be particularly suitable for mills making molded paper products, for paper specialties and for laboratory work. It is able to handle entire pulp rolls or uncut bales of mixed papers, wires and all, according to the manufacturer.

Equipment Briefs

FOR PROVIDING a true standard for comparing the color fastness of dyes, dyed textiles, paper, plastics and other products, the National Carbon Co., Cleveland, Ohio, has introduced the new National accelerated fading unit, Type

XV. Special effort has been made to insure closely controlled and reproducible conditions. In duplicating the fading effect of natural sunlight, the radiation source is this company's National Sunshine carbons, with the arc inclosed in a cylinder of Corex D glass to filter out most wave lengths not present in sunlight. Eighteen specially designed sample holders are carried on a revolving rack within the inclosing drum. A motor mounted on the outside of the drum drives the rack at 1 r.p.m. An annular water trough below the sample holders, containing an immersion heater and automatic thermostat, can be adjusted to maintain either high or low relative humidity during the tests.

SEVERAL design improvements have been announced for the Allvent general-purpose ventilating fan first marketed about a year ago by Autovent Fan & Blower Co., 1805 North Kostner Ave., Chicago, Ill. In the original model a three-bladed construction was used, which has now been changed to a multi-bladed fan unit designed to overcome normal restrictions in airflow, to prevent churning of the air, and to absorb shocks and sudden changes in air loads. The new type fan wheel is claimed to deliver maximum volume of air at lowest power consumption. Sizes range from 5,000 to 23,000 c.f.m. inclusive. All types are V-belt-driven from a standard 1,725 r.p.m. motor.

TO PERMIT formation of a bronze alloy bearing with the strength of steel, Johnson Bronze Co., New Castle, Pa., has developed a new pre-cast bronze-on-steel material. Bronze of the desired composition is first cast in solid bars, the center of each casting being removed by drilling. The borings are reduced to a powder, treated in a hydrogen furnace, then permanented bonded to strip steel. The composite strip is then formed into bearings by a combination of stamping and forming operations. Graphited bronze and special alloys are available.

TO FACILITATE accurate timing operations, as in laboratory procedures, time study, etc., the Precision Scientific Co., 1750 North Springfield Ave., Chicago, Ill., has announced a new electric stop watch known as the "Time-It" Minute Model, run by a synchronous electric motor which operates a direct reading indicating counter. The device integrates to 1,000 minutes, reading in full minutes and hundredths of a minute It can be reset to zero from any reading, or successive readings can be totaled.

PATENTS covering design improvements for the elimination of hydraulic losses in pumps, with increased efficiency said to be as high as 10 percent, have recently been granted to Pomona Pump Co., St. Louis, Mo., and Pomona, Calif. These improvements, now included in all sizes of this company's vertical turbine pumps, involve fundamental design changes in the guides vanes which alter the flow direction of the liquid being pumped from horizontal to vertical. In previous practice these vanes were constructed as thin as possible on the advance edge. However, the company has discovered that this produces eddy-friction losses which can be avoided by forming the advance vane edges of a bulbous shape so that, regardless of the flow direction of the fluid, its direction will always be substantially tangent to the vane surface. To obtain advantage of this improvement, owners of vertical turbine pumps can modernize by the substitution of new bowl assemblies.

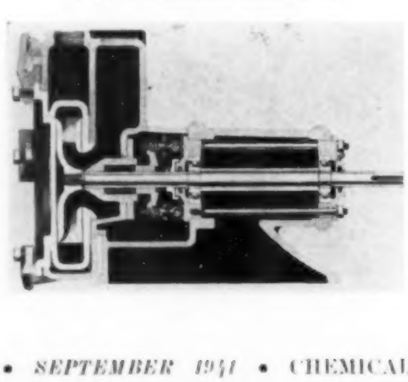
A NEW protective apron for chemical workers, said to resist oils, tars, greases, acids, chemicals, paints, varnishes, lacquers, solvents, petroleum products, creosote, naphtha, and alkalies, has been announced by American Optical Co., Southbridge, Mass. The material employed, known as AO Protectocote is stated to be totally different from conventionally used materials, to be tough, light in weight, heat-resisting and unburnable.

MOUNTING from any one of four sides for use as an interlock, limit, or push-button switch is possible with a new splash-proof precision switch introduced recently by Micro Switch Corp., Freeport, Ill. The switching element is a Bakelite Micro switch inclosed in a removable cover and actuated either by a roller arm or push-rod plunger. Carrying capacity of the switch is stated to be 1,200 watts at up to 600 volts a.c.

Horizontal-Shaft Pump

FOLLOWING UP the introduction earlier this year of the Amsco-Nagle vertical-shaft pump, American Manganese Steel Div. of American Brake Shoe & Foundry Co., Chicago Heights, Ill., is now producing a line of Amsco-Nagle horizontal-shaft pumps. Designated as Types A and T, the new pumps are built in sizes from ¾ to 6 in., for operating heads to 100 ft. A variety of materials including manganese steel, various cast irons, various ferrous and non-ferrous alloys can be employed. Four impeller types are available, including both open and shrouded. The Type A pump is the one shown, while Type T has a horizontal intake opening, concentric with the shaft. These pumps are designed especially for the handling of sludges, slimes and slurries.

Type A horizontal shaft pump

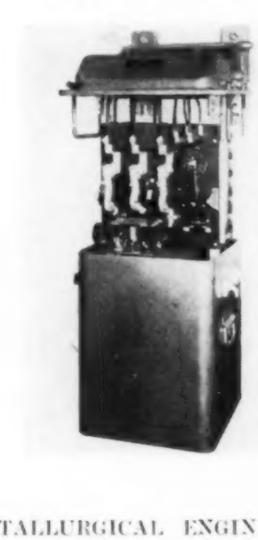


Corrosion-Proof Starters

TWO NEW low-voltage oil-immersed starters, especially designed to resist corrosion in chemical plants and oil refineries, have been announced by General Electric Co., Schenectady, N. Y. These wall-mounted starters designated as CR7008 and 7006 employ a heavy corrosion-resisting cast-iron head supporting the mechanism and oil tank. The tank is of 3/32 in. steel. Both types are available in construction suitable for use in hazardous-gas locations. Type CR7008 is a combination starter, including all equipment necessary for controlling and protecting a motor. A manually-operated circuit breaker for short-circuit protection and disconnecting, and a magnetic starter for push-button control of the motor are included. Type CR7006 is a magnetic starter similar to the other, except that it does not include the manual circuit breaker and hence is to be used where other provision has been made for short-circuit protection and disconnecting.

Also for use in corrosive atmospheres is a new line of metal-clad switch-gear for ratings to 15,000 volts, with breaker ratings as high as 500,000 kva. The equipment is similar to the company's standard metal-clad switch-gear for general industrial use, but has a number of special features for corrosion protection and protection against hazardous atmospheres. Among these are special sealing methods and the use of explosion-proof boxes for the secondary control devices. Special corrosion-resisting finishes are used and the inner surfaces of roof and side sheets are lined with pulverized cork to prevent condensation.

Corrosion-resisting starter



THIS FLOW PATTERN

to materially cut your valve performance costs

With these three features—all in one valve, you are getting Valve performance that gives you cost saving benefits that begin with the installation and last for years.

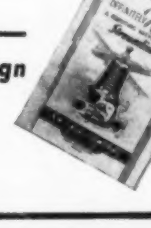
Benefits

- maximum capacity when needed most
- accurate pressure control under toughest working conditions
- trouble-free service
- smooth operation
- tight closure
- accurate regulation
- speedier production results
- elimination of failures
- constant delivery pressure
- cost saving operation
- no service attention
- no spoilage
- practically zero in maintenance costs

First, the streamlined flow around the inner valve; then the straight path for the fluid through the flow tube; then the aspirator which turns small pressure changes into large valve operating forces. These things have made the Streamliner click.

But you can find out for yourself why users install this valve and then are able to forget it because it requires NO service attention —gives users NO trouble. Simply write for a 30-day FREE trial. After this 30-day trial you either pay the bill or return the valve to us at our expense.

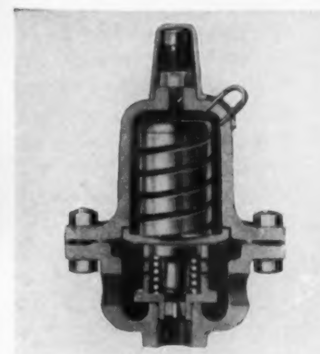
★ *Send for Bulletin 1000 — gives you complete design and operating facts.*



A CASH STANDARD "GET ACQUAINTED" COLUMN

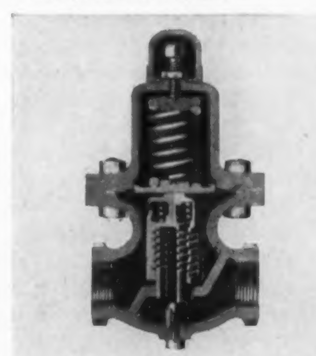
Question: "Don't you people make anything besides that Streamlined Valve you talk about so much?"

Answer: "Yes Sir; we do! And we propose to picture one or two of them here each time."



Cash Standard Type Q Relief Valve; maintains constant upstream pressure by relieving into lower downstream pressures, regardless of variations in downstream pressure. For steam, water, air, oil, many gases. (Similar valve for refrigeration fluids.)

Iron or bronze bodies; bronze trim; pressures up to 350 lbs.; top temperature 500° F. Screwed ends; sizes 1/4" to 2".



Cash Standard Type 4190 Valve; holds constant back pressure on inlet side regardless of variation in outlet pressure or changes in load. A multiport, large capacity valve. Used on suction line in refrigeration practice. Also used extensively as bypass valve for oil pumps.

Iron or bronze bodies; iron trim. Screwed ends 1/2" to 2"; flanged ends 1 1/4" to 6".

☆

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CASH STANDARD CONTROLS VALVES

Soybean Oil Extraction With Normal Hexane

BECAUSE A MUCH HIGHER YIELD of oil may be realized by solvent extraction than by the usual pressure methods, the number of extraction plants in operation in the United States has increased to over eight. These extraction plants are now processing over 20 percent of the one and one-half to two million tons of annual crush. Previous to 1934 there were no large-scale solvent extraction plants in this country. The first extraction plants put into operation in this country were of foreign manufacture, but at present there are at least three firms in the United States making solvent extraction equipment.

The residual fat content of meal processed by the pressure method runs from 4 to 5 percent, while solvent extraction produces a meal with 0.6 to 1 percent residual fat. The accompanying flow diagram shows the process used in the Allis-Chalmers plant installed for Honeymead Products Co. of Cedar Rapids, Iowa.

The beans from storage are cleaned, weighed and cracked. The cracked beans are then tempered and partially dried after which they are rolled out in thin flakes. The flakes are then fed into the top of the extraction column, the level of flakes being held constant in the top of the column by an automatic device. The flakes flow down through the column against a counter flow of hot solvent flowing up. The miscella (solvent and oil solution) is taken off through a screen at the top of the column, and flows to the miscella settling tanks. After settling, the miscella is passed through a preheater condenser utilizing waste heat from the distillation system, and then through a straight preheater and into a calandria where it is flashed to a solvent vapor and oil droplets by steam. The vapor chamber at the top of the calandria effects a separation of the solvent vapor and oil droplets. The solvent vapor then passes to the preheater condenser, after condensation to a solvent cooler, and back to the solvent storage tanks. The oil at the bottom of the vapor chamber flows through a preheater and into a bubble cap stripping column where the last traces of solvent are removed.

The extracted flakes are expelled from the bottom of the extraction column by a large screw working against a pressure-loaded cone. The flakes are then passed through a bank of indirect dryers where about 98 percent of the solvent is removed, then through a direct dryer where superheated steam is blown through the flakes and into a condenser, thus removing the last traces of solvent from the flakes.

The salient features of this particular plant are first, its very low solvent to bean ratio. At normal tonnage and a residual fat content in the meal of 0.65 percent, the solvent to bean ratio is 0.9:1, by weight. Second, low power consumption. The power consumption approximates 65 kwh. per ton. Third, labor for preparation and extraction runs at 0.7 man hour per ton.

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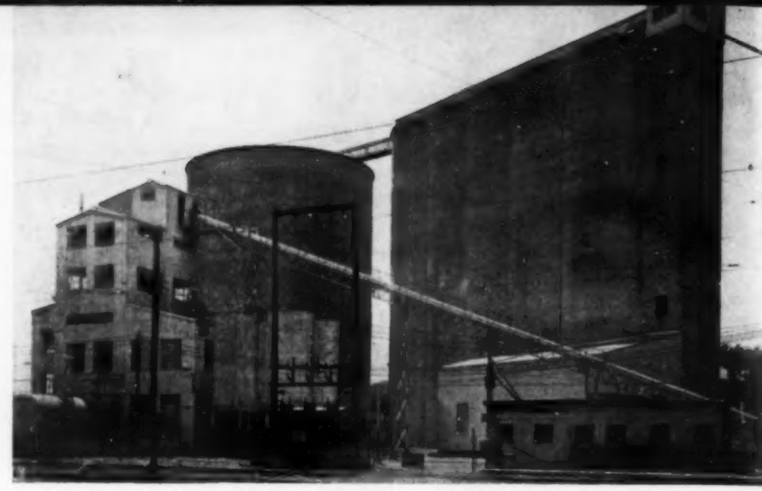
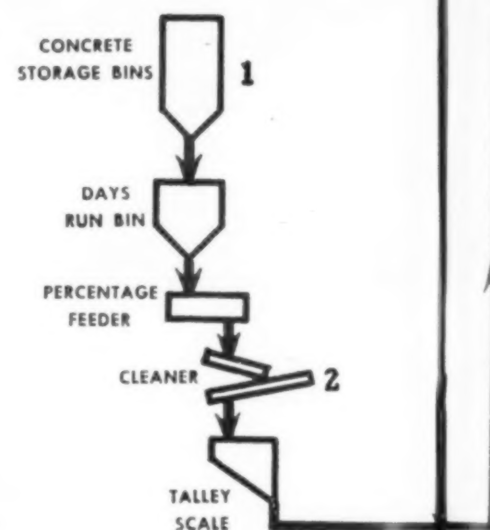
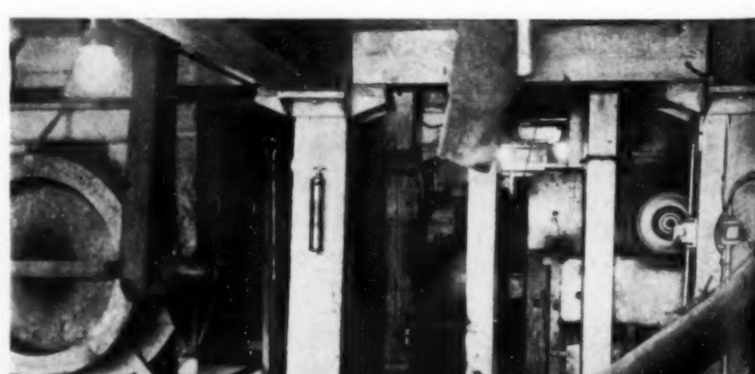


1 Northeast view of extraction plant and storage bins

A *Chem & Met* FLOW SHEET

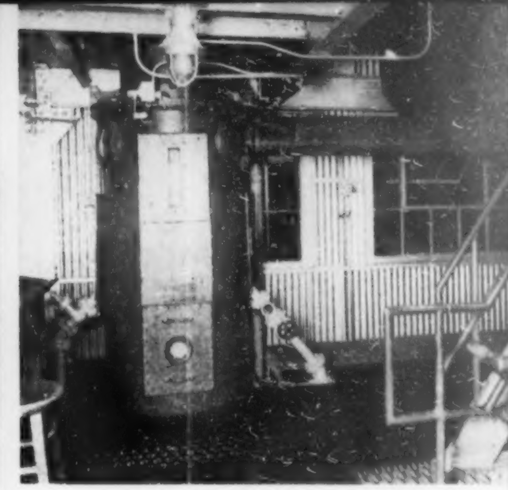




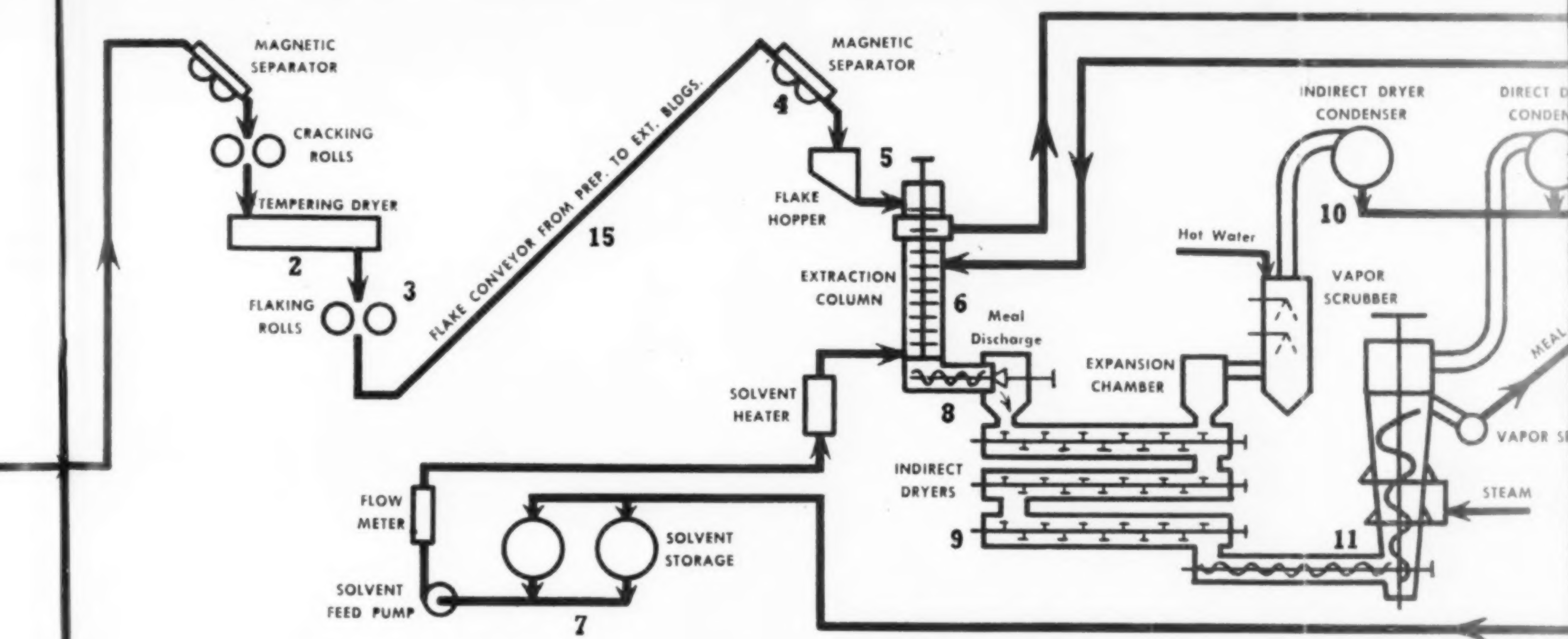
2 Left to right, tempering dryer, cracking roll and cleaner on second floor of preparation department

Allis-Chalmers flaking rolls on first floor of preparation department

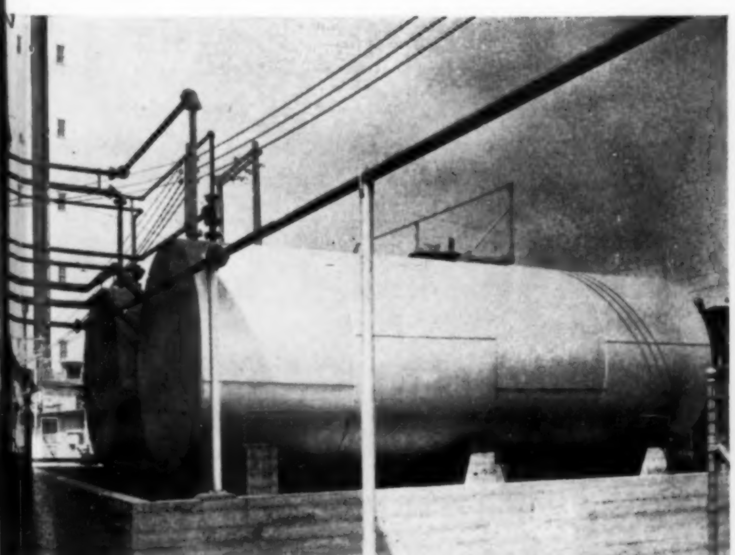
4 Flake conveyor discharge through magnetic separator into flake hopper on fifth floor



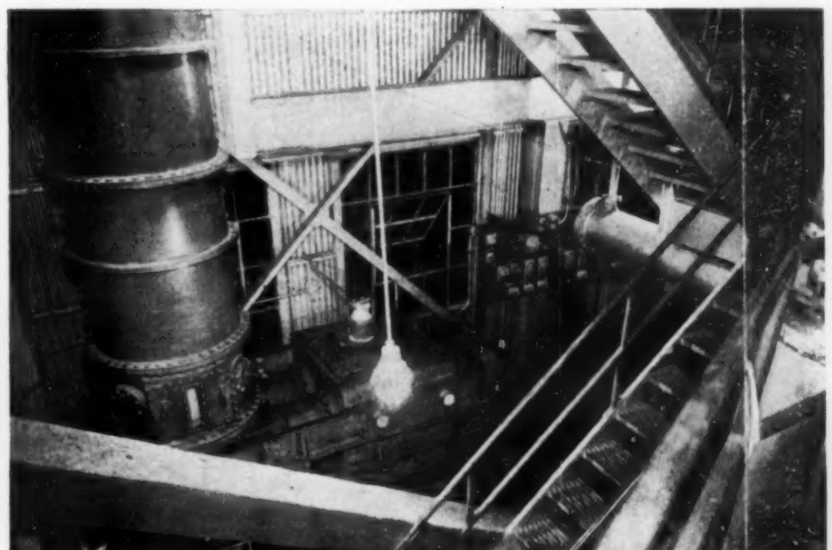
5 Bottom of flake hopper, flake feed to screw to and top of extraction column



floor



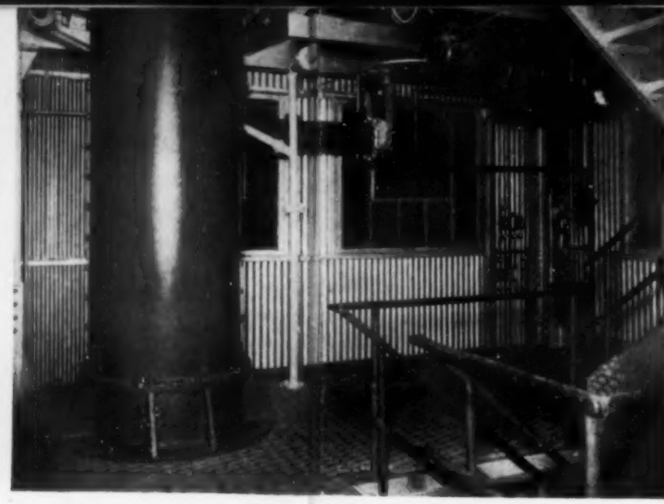
olvent storage tanks showing unloading, feed and vent pipes



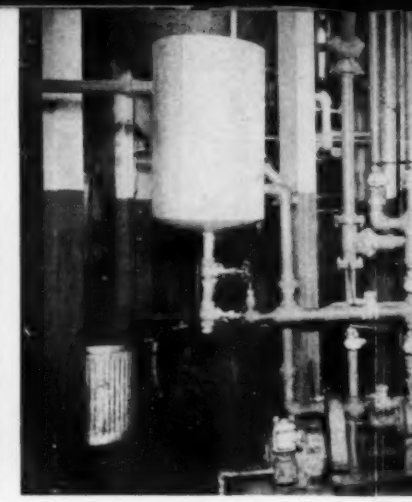
8 Extraction column discharge mechanism. Extraction system control panel at right center on second floor

9 At left is the oil first floor

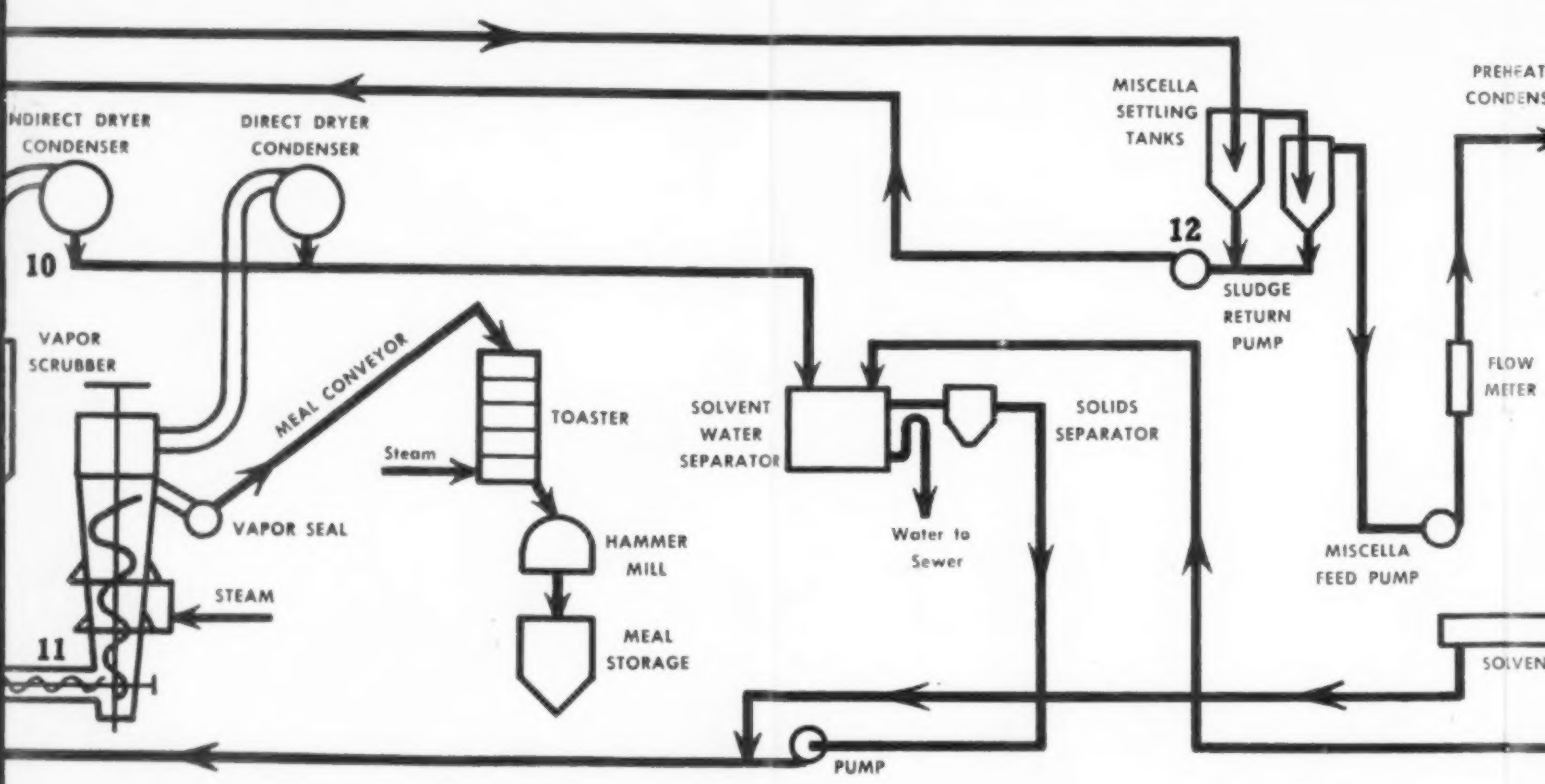
e hopper, flake feed to screw to column
tion column



6 Section of extraction colums under that shown in 5



12 At right is solvent feed pump to e
center is solvent unloading pump



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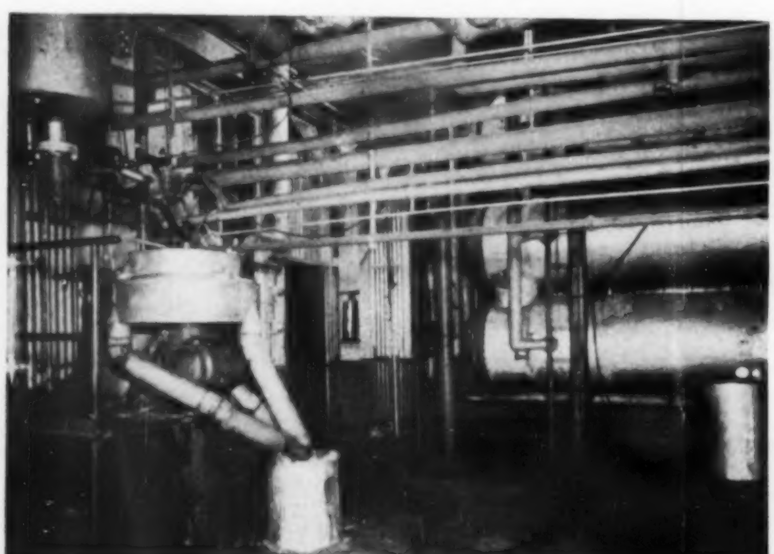
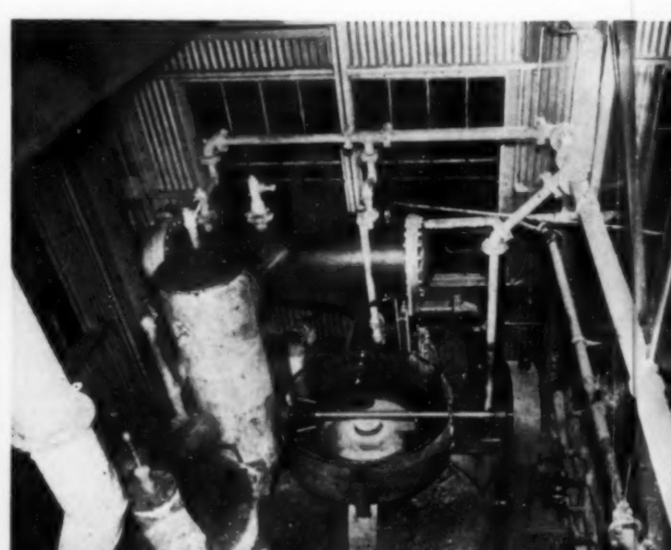
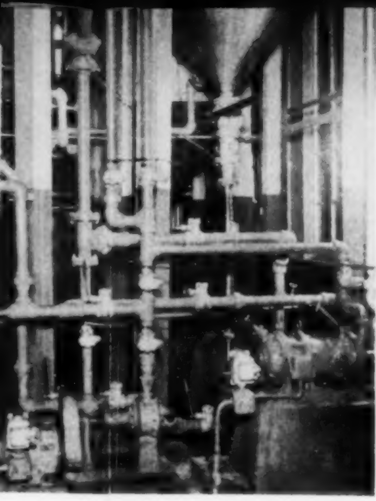


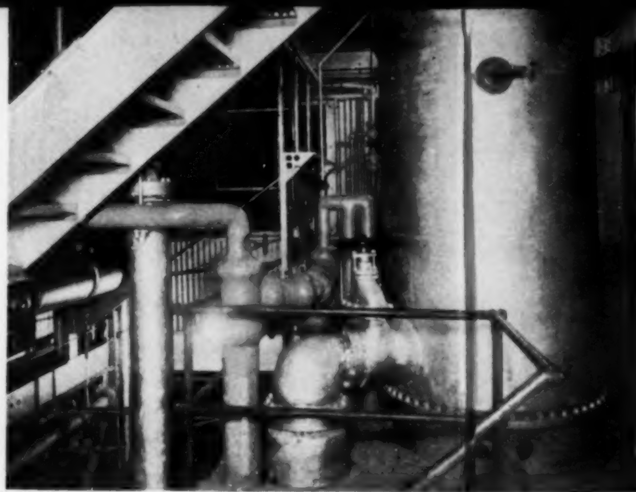
9 At left is the oil centrifuge, right background is indirect meal dryers on first floor



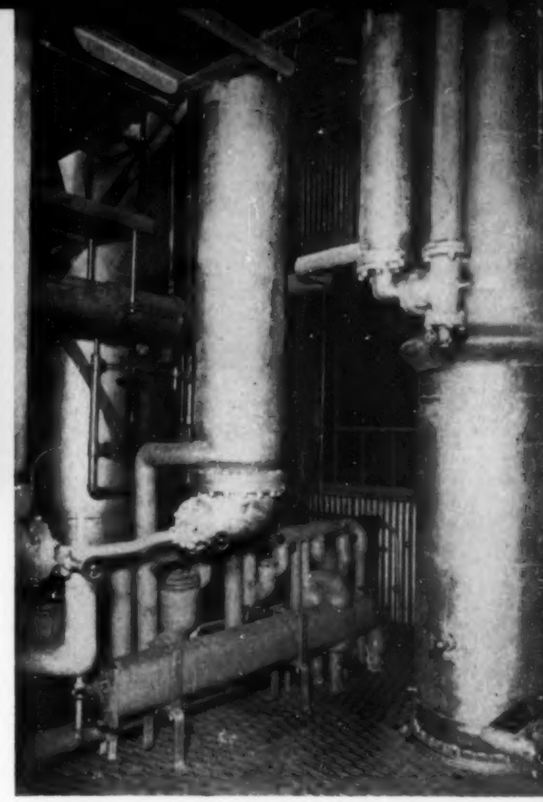
10 Meal dryer vapor domes, scrubber and condensers at left ce
center is direct dryer on second floor



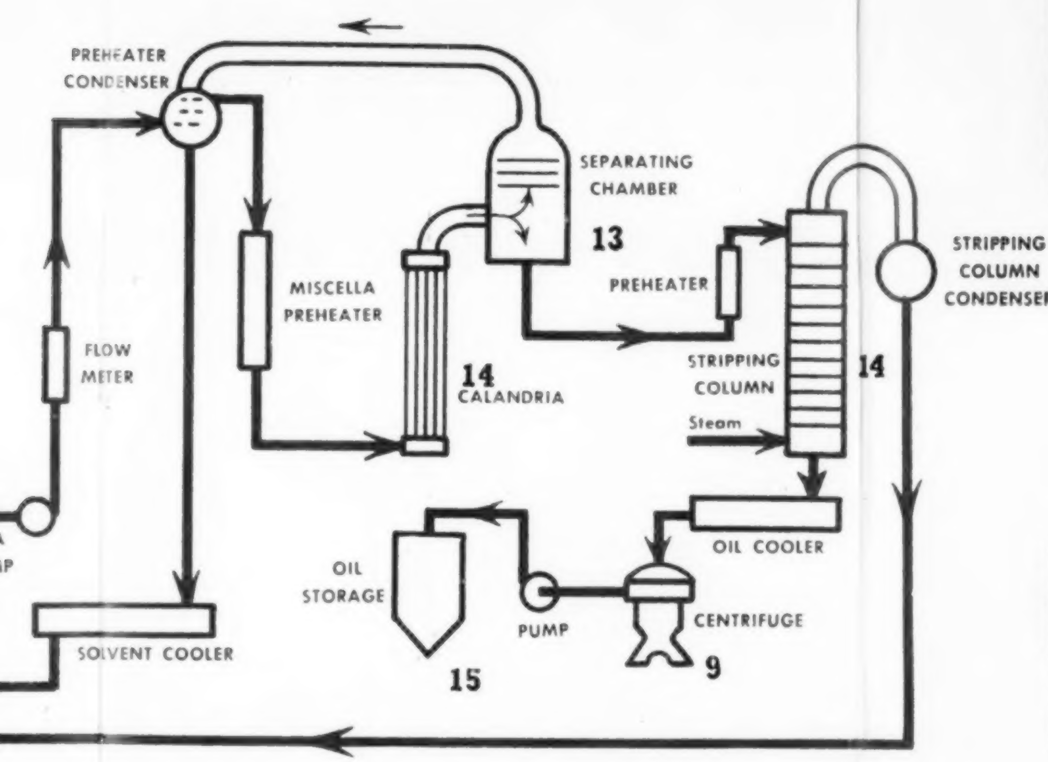
...leed pump to extraction column; ...ng pump



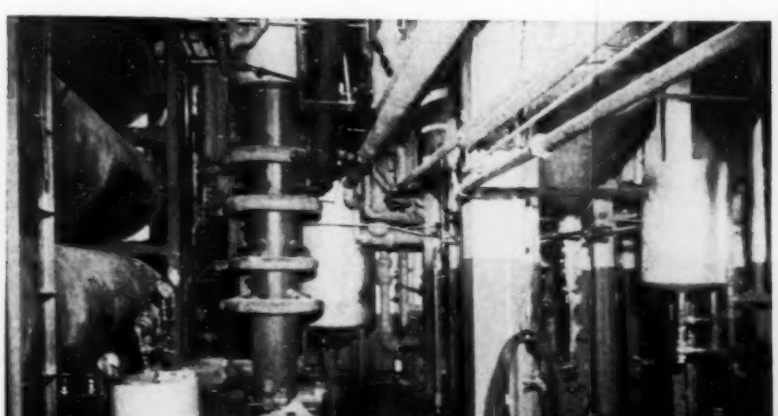
13 Miscella distillation equipment. At left against wall is the solvent cooler



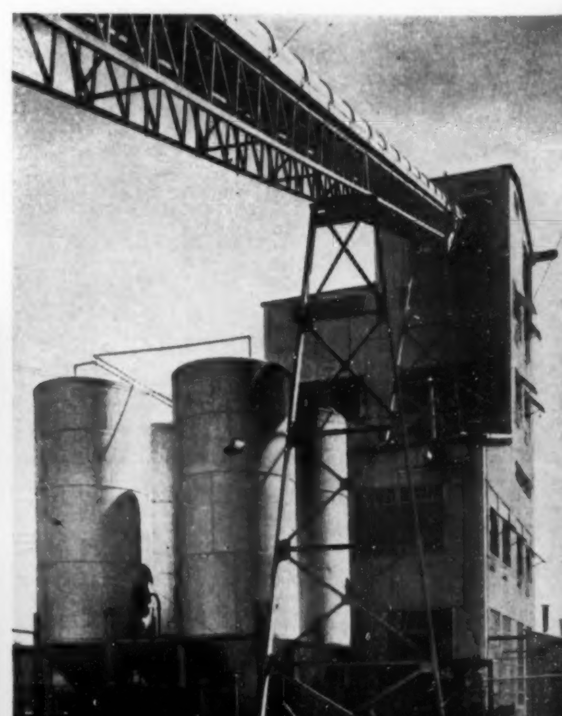
14 Left center is bottom of miscella calandria. Upper right center is miscella preheater to stripping column. Right is the stripping column on second floor



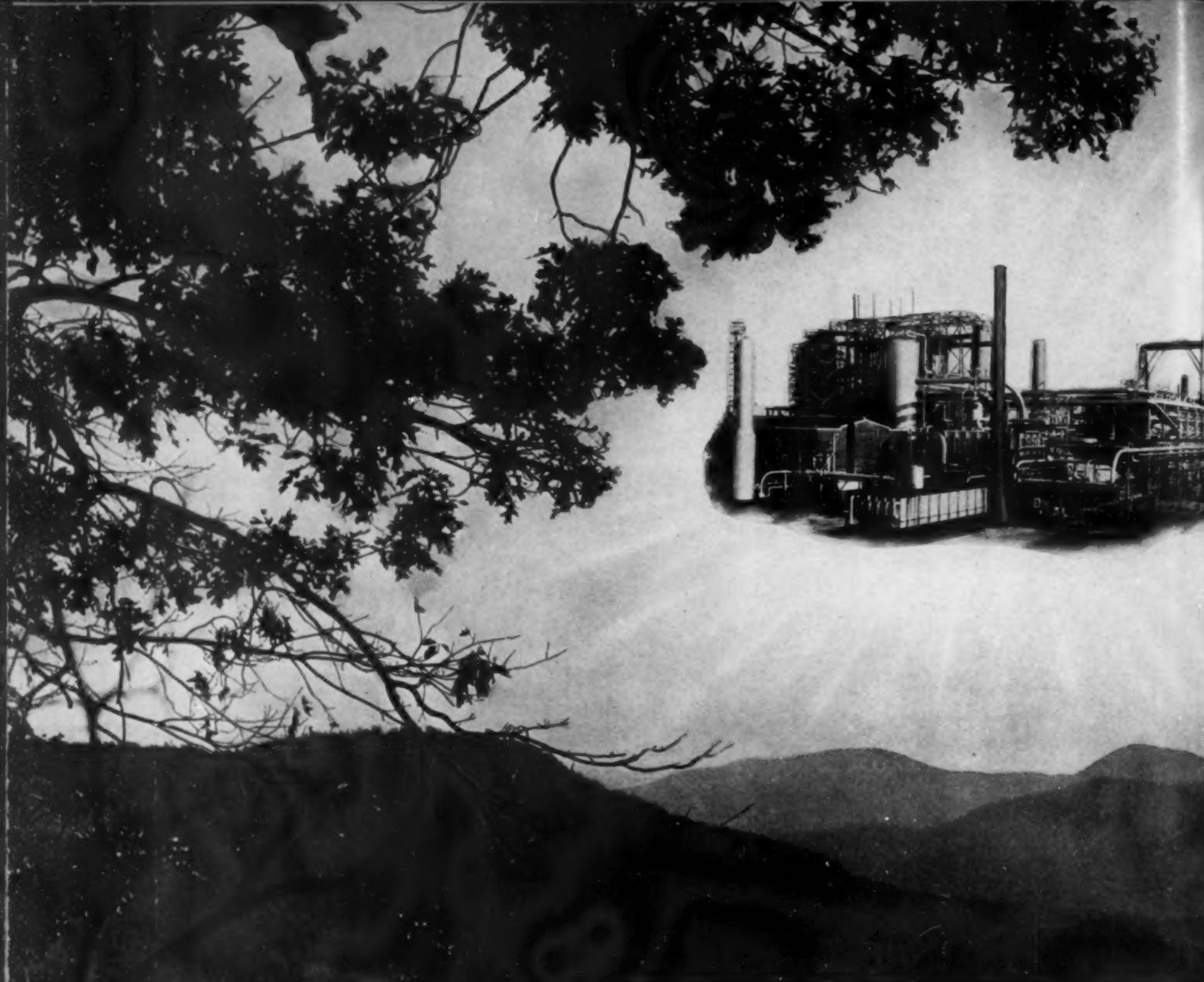
...sers at left center. In



11 Left are indirect meal dryers; left foreground is centrifuge sludge recovery apparatus. In center back are direct meal dryer and solvent water separator



15 Northwest view of extraction plant and oil storage tanks



BLAZING NEW TRAILS

This chemical era of ours is just dawning. Like the early settlers we're still standing on the shores of the Atlantic with a vast, uncharted wilderness lying to the west ready for development.

To those companies imbued with the pioneering spirit and driven by an urge to "*do things*", Badger offers an organization of engineers and construction men of kindred thought. Having travelled most of the trails to date, Badger technicians will be glad to help — first as guides and trail blazers in processing and then as designers and constructors of trail-blazing processes, equipment and plants.

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Chemical Engineers and Contractors

Technical, Industrial, Personal

Chem & Met NEWS

PERSONNEL SETUP OF CHEMICAL SECTIONS OF OPM AND OPA

Despite the reorganization of defense administration and creation of the super-board, Supply Priorities and Allocation Board, to act as "umpire" in OPM-OPACS differences and assume general planning control of the war effort, the OPM and Civilian Supply commodity sections are retaining nominally separate identities.

In chemicals this makes little practical difference because the Weidlein group and the Civilian Supply Section set up in the old OPACS by Professor Donald B. Keyes have always worked together. In other fields the tendency is in this direction but, except for the automotive group, practical integration still lags. As the importance of commodity organization grows—an inevitable development of the new defense alignment—it is expected that OPM's new Civilian Supply division, taken over bodily from OPACS, will atrophy and be absorbed in the OPM units.

In early September, the personnel setup of the two chemical sections looked like this:

In OPM, the branch headed by Dr. E. R. Weidlein was doing business at the old stand, with Dr. E. W. Reid and George Moffett as assistant chiefs. Mr. Moffett, president of Corn Products Refining Co., came to Washington originally as Knudsen's food production man and later temporarily headed the minerals and metals division of OPM's Production Division (prior to creation of commodity units). Also on the administrative staff are Dr. D. P. Morgan as senior consultant and priorities specialist, Lyman Chalkley, research and statistics, and F. H. Cabot, priority liaison.

Staff specialists are J. W. Wizeman, chlorine and alkalies, with Col. W. H. Chamberlan assisting on chlorine; J. B. Davis, paints and pigments; A. E. Peterson, solvents and resins; Campbell Osborn, cellulose, glycerin and inorganics; W. W. Odell, coke, coal and tar byproducts; and Felix Stapleton, ammonia, sulphuric acid and heavy chemicals.

In the Civilian Supply group, Lawrence Brown, an experienced government investigator, is executive officer, with Frank Talbott, until recently associated with C. R. DeLong as consulting chemical engineer, and M. L. Griffin, market analyst of Westvaco, as senior staff members. Other staff members are M. E. Clark, formerly with *Chem. & Met.* and more recently with Michigan Alkali; E. M. Houts, associated with Mr. Griffin; G. William Fane, Victor Boutin, O. E. Goddard, H. J. Schnell, Jr., and Melvin Goldberg. Definite assignments have not been given the individuals on this staff.

Additions to both the OPM and the CS staff may be expected, as Dr. Weidlein and Mr. Brown can locate experienced men. In their present setup both staffs are undermanned for the job already before them, and this load is growing rapidly.

The reorganization left the Office of Price Administration a separate entity in the defense setup and in this agency, Oregon B. Helfrich of Jenkintown, Pa., has been named to handle chemical price matters. Before the severing of prices and civilian supply, it had been expected the Brown staff would double in price matters, but now OPA probably will set up a separate unit.

PORCELAIN ENAMEL INSTITUTE TO MEET AT COLUMBUS

The Sixth Annual Porcelain Enamel Institute Forum will be held at Columbus, Ohio, Oct. 8-10. The Deshler-Wallick Hotel will be headquarters for the meeting but all discussions will be held on Ohio State University campus. On the opening day the Product Standards Section committee will discuss technical developments of the past year and recommend a plan of research for next year. In the afternoon there will be a symposium on automatic and low pressure spraying.

On Oct. 9, a general session will cover screen process decorating and automatic pickling. Carl Harbert of the Harshaw Chemical Co. will preside. The P.E.I. research fellow, William W. Coffeen will report on the work he has carried during the year at the National Bureau of Standards. A symposium on training men for the industry also will be held.

The morning of the closing day will be devoted to discussions of controlled atmosphere furnaces and related problems of fish scaling. N. G. Wedemeyer of Rohm and Haas will act as chairman. Operating problems, especially those bearing on securing maximum production out of present plant facilities, will be the topic for the afternoon session.

SYMPOSIUM ON CORROSION HELD AT GIBSON ISLAND

The third annual meeting of the American Coordinating Committee on Corrosion was held last month at Gibson Island, Md. The meeting was planned to coincide with the first Symposium on Corrosion sponsored by Section C of the American Association for the Advancement of Science. Dr. R. M. Burns, assistant chemical director of Bell Telephone Laboratories, served as chairman of the technical sessions which were continued over a five-day period with papers presented by outstanding experts in the corrosion field.

At the official committee meeting Dr. F. N. Speller, representing the American Chemical Society and the National Research Council, was re-elected chairman for 1941-1942; Dr. R. M. Burns, representing the Electrochemical Society, was named vice-chairman; and Dr. G. H. Young of the Mellon Institute of Industrial Research was named secretary-treasurer.

CHEMICAL FIELD LABORATORIES IN ARMY FORCES

While some companies of the Army may claim to be the best drilled and others may be proud of their marksmanship record, chemical field laboratory companies of the Chemical Warfare Service claim to excel in general education. More than half of the 150 officers and men in the First and Third companies recently organized and now undergoing training at Edgewood Arsenal, Maryland, hold college degrees.

Chemical laboratory companies are assigned to field forces to insure prompt scientific investigation of certain chemical warfare problems as they arise in the field. The company identifies the various kinds of enemy gases and examines captured enemy chemical munitions. It also tests canisters of gas masks that filter and purify the air breathed by the wearer. The company recommends decontamination methods, assists the Engineers in water purification, and examines enemy gas masks and other such protective equipment for information of the enemy's chemical warfare preparations or intentions.

LICENSE REQUIRED FOR PATENTS FILED IN FOREIGN COUNTRIES

Applications for patents or registration of a utility model in a foreign country now must first be licensed by the U. S. Commissioner of Patents. Special legislation to plug a loophole in the patent laws and make sure no American invention reaches unfriendly hands has been enacted by Congress.

The new law is an amendment to the 1940 act which permits the Commissioner to issue an order of secrecy prohibiting foreign filing of any patent considered useful to national defense.

News from Washington

WASHINGTON NEWS BUREAU, McGRAW-HILL PUBLISHING CO.

CHEMICAL manufacture must be speeded. Every effort of every Defense agency is being made to this end. It is recognized that even with priority control there will be shortages of many things vital to both military and civilian affairs. It is difficult to overstate the scope or the seriousness of the situation.

The cause of these shortages is not difficult to identify. Multiplication of defense manufacture has come at a rate far exceeding the most extreme estimates of a few months ago. And the consumption of certain important chemicals per unit of defense activity far exceeds the expectation of the Army which undertook certain estimates along these lines during the ten years preceding the present speed-up. Not only are chemicals so involved, but many other raw materials of process industry also present acute problems for Washington solution.

Alcohol Plan

Official Washington by quiet collaboration of several groups has developed a novel program which promises production of a large gallonage of industrial alcohol from new sources. The whiskey distillers will produce this product under an arrangement by which the government can supply surplus corn from S. M. A. stocks and pay for the processing, presumably in the end by purchasing through Defense Supply Corp. or some such R. F. C. subsidiary.

It is hoped that as much as 50 million gallons can thus be obtained without further loading of those who normally make industrial alcohol. They were already loaded to full plant capacity. And the prospect was that the 1941-2 output would not exceed 220 million gallons which was only about three-fourths of the estimated requirement.

These arrangements were worked out through collaboration of Commerce Department, R. F. C., OPACS (now O. P. A.), and O. P. M. officials. They were initiated in connection with conferences at which the distillers sought priority for the goods which they themselves needed either for manufacture or packaging of their beverage products. Since the distillers left Washington apparently quite happy, it may be concluded that both the government and the industry have made a satisfactory arrangement fully to utilize otherwise unavailable manufacturing capacity.

Incidentally, those distillers which have no equipment for making industrial alcohol may either collaborate with other neighbor distillers for final rectification or may, in a few cases, get new equipment to step up their 100 proof beverage facilities to the 190 proof base needed for industrial alcohol.

Alumina Contracts

Two large plants will be built in Arkansas each to make a half billion pounds of Al_2O_3 from bauxite mined in that State. These plants will be financed by Defense Plant Corp. with the engineering and operation by Aluminum Co. of America. The alumina made at one plant will presumably be used by Alcoa; but the production of the other will be allocated by the government to other firms who are building aluminum making plants for the government.

For present operations low grade bauxite of Arkansas will be utilized at both alumina works. The Bureau of Mines estimates that at least 15 million tons of such ore reserve are available. About half as great a reserve of high grade ore is believed available in the same State; but it will be retained for the present in order that its special characteristics be later available for chemical and abrasive purposes should import of high grade ore be cut off altogether.

O. P. M. has also recommended that the War Department initiate small scale operation of a plant to make alumina from alunite at Marysvale, Utah. The process proposed for use has been developed by Kalunite, Inc., which is affiliated with Olin Corp., a contractor for one of the aluminum works. This process will employ Utah mineral of which the Bureau estimates reserves to be adequate for at least ten years operation if 120 million pounds of alumina are made per year.

Even with all present contracts there remains still to be provided several hundred million pounds of alumina before full raw material supply for all projected metal plants will be available. It is anticipated that the Utah developments will make up part of this deficit, but not all. Incidentally, the shortage of alkali for processing is beginning to be one of the worries of the aluminum planners.

During August Alcoa announced that it would cut the price of metal delivered to the government after September 30 from 17 cents to 15 cents per pound of ingot. This is the fourth price reduction within eighteen months. The price of ingot metal was 20 cents before the first reduction in March 1940.

Ammonia Plans

The third ammonia program is being organized. In the first there were two parts, one providing for an increase in commercial ammonia capacity and the second providing three new government-owned plants at Morgantown, West Henderson, and Muscle Shoals. The second ammonia program also provided three plants, at Monroe, La.; Louisiana, Mo., and a second plant in Morgantown.

The third program must provide about as much more government-owned or government-financed capacity as either of the first two government paid projects. This means that O. P. M. and Army executives must find industrial folks ready to build 500 tons per day of new capacity. This, it appears, would be much easier if the Army were willing to let R. F. C. finance some of the new developments so that purchase by the agent-operator companies would be possible at the end of the emergency. Also helpful would be a waiver of the safety belt requirement which now precludes building some of these works near the Gulf of Mexico at points favored by competent industries. Regardless of these and other considerations, O.P.M. must and will find the ammonia.

New Magnesium Plants

Two new plants for the manufacture of magnesium were announced by the Federal Loan Administrator on Sept. 10. The largest of these will be built and operated by the Dow Chemical Co. It will be located near Freeport, Texas, will have an annual capacity of 72,000,000 lb. and will cost approximately $52,000,000. The other will be at Painesville, Ohio, built and operated by Diamond Alkali Co. It will have a capacity of 36,000,000 lb. and will cost about $16,000,000. Both plants will use the Dow electrolytic magnesium chloride process.

Getting Equipment

Every metal is scarce. Hence, chemical engineers require much ingenuity and considerable knowledge of the priority procedure if they are going to get any reasonable deliveries on needed machinery and equipment, or even repair and maintenance parts. There are priorities available for much of this purchasing. But it takes "more than a piece of paper with a number on it" to secure actual delivery when the machine shops are already full of orders with high priority classification.

The greatest aid in securing prompt delivery is often the selection of a proper metal. O.P.M. officials ask that in design work all engineers use metals as far as possible toward the bottom of the following list, which is arranged in the order of increasing availability of the metals: Magnesium, aluminum, nickel, copper, zinc, lead, iron, and steel. Inventories of these and numerous other metals are being taken among users as well as producers, the purpose being to determine the actual present status of the country with respect to scarce metals, which means almost all metals.

One problem of Washington now is to determine whether disappearance of metals means their actual use.

It is hoped that much of the building up of working supplies in the shops of the country has been accomplished and that disappearance will now come closer to consumption.

Chemical engineers needing equipment or machinery built under priorities can request shops to do the building from metals in their present inventory. The priority to which the shop is entitled for the securing of raw materials will ensure that they get replacement metal in due time. But the shops are not expected to wait for a specific shipment of a metal before building or making deliveries on the machinery covered by that priority. In some cases insistence on observance of this ruling of O.P.M. may be very helpful for chemical enterprise.

Priorities

Priority actions of interest of the chemical industry are coming in greater numbers as the impact of the war program cuts more deeply into normal civilian economy. Four recent orders from OPM's Priorities Division affect certain chemical lines.

One order places formaldehyde, paraformaldehyde and hexamethylen-etetramine, and synthetic resins made from these chemicals, under complete priority control. The usual requirement that defense orders be filled first and that manufacturers must accept such orders is included, plus a detailed outline for allocation of civilian supplies of plastics. A B-4 rating (highest allocated for non-defense) is given for plastics for essential public services including material and equipment for scientific research. Household equipment, autos, radios, commercial photography, etc., are lumped in a second group with a B-8 rating. Prohibited are amateur photography, smoker's articles, toys, advertising items, hardware, etc. This is the first priority order flatly prohibiting production of specified articles.

Putting into effect an OPACS civilian allocation program, OPM also outlined preference classifications for filling non-defense orders for chlorinated hydrocarbon refrigerants. Chlorine previously has been placed under full control. Refrigeration equipment already installed and air conditioning in hospitals, clinics and sanatoria get first call, with other uses following in this order: Industrial air conditioning already installed; other air conditioning already installed; new refrigeration and air conditioning equipment.

Another order by OPM, also carrying into effect an OPACS recommendation, prohibits sale of second-cut cotton linters, or more than 20 percent of mill-run linters, for any purpose other than ultimate use in the chemical industry. A further requirement prohibits crushing mills using two cuts to regulate their processes so that first-cut linters do not exceed 20 percent of the total cut. Deliveries at variance with the order under contracts entered into prior to July 31 must have OPM Priority Division okay.

In addition to these priority actions, OPM's Purchases Division has arranged to obtain adequate steel to fill defense orders from the petroleum and chemical industries for steel drums and containers. Manufacturers are to submit PD-1 forms for steel equal to the amount needed to produce two-thirds of their normal output during September and October; they will get an A-5 rating. Before the end of this stop-gap period, a permanent priority program for this production is to be worked out.

Five other orders were issued simultaneously on Aug. 30, putting under full mandatory control all supplies of ethyl alcohol, methyl alcohol, potassium perchlorate, potassium permanganate and toluene. All of these actions specify that suppliers must accept all defense orders offered them and that unrated defense orders shall be given an automatic A-10 classification to insure their delivery ahead of any civilian supplies. Quantities of these compounds left after defense shipments are made will continue to be distributed through normal commercial practice.

Chemicals Shortage

Official admission has been made of serious chemical shortages about which only whispers were formerly allowed. Starting off with chlorine and chlorine derivatives, the problems of O.P.M. and O.P.A. rapidly spread over formaldehyde and methyl alcohol for plastics and through pretty much the whole list of solvents and anti-freeze chemicals. The solvents situation has become so bad that any user of any of these materials is practically assured of trouble unless his application is on or directly tributary to a defense undertaking.

Anticipating the difficulties which have been encountered in other industries, O.P.A. announced at the end of August that price levels prevailing at the end of July should be maintained with respect to most industrial solvents. It was definitely asked that any manufacturer or marketer consult with O.P.A. before raising any prices. Among the "solvents" named as subject to this restriction were the following chemicals (some of them obviously not solvents): Acetone, acetic acid, acetic anhydride, methyl acetone, ethyl acetate, normal and secondary butyl acetate, dibutyl phthalate, methyl alcohol of all grades, ethyl alcohol, isopropyl alcohol, and normal and secondary butyl alcohol.

O.P.A. Price Division executives have been very complimentary in their comment on chemical marketing. One such official went so far as to say that they were trying to teach other industries to follow the practice which had long been the habit of the chemical industry. He was referring to the policy of constantly lowering prices and sharing with customers, as well as with investors, managers, and labor, the benefits of improved technology. This situation has resulted in very sympathetic and understanding care of chemical price questions which have occasionally been presented at O.P.A. There has been no apparent desire to sit on the price lid arbitrarily. Where actual increases in cost have been shown, O.P.A. appears willing that price advances be made without challenge by the government. However, they are extremely anxious to prevent any stampede or upward spiraling in the chemical markets. It is to avoid that contingency that they seek advance notice of contemplated price changes wherever possible.

Petroleum Controversy

During the first week of September controversy over shortage of petroleum in the Eastern states developed into an unsavory mud-slinging contest. It appeared in some cases that "the one who lied the loudest" was the one that was going to be believed. The railroads make no pretense of denying their selfish interest in securing rail transportation instead of further pipe line development. They are, quite naturally, terrified at the thought that big pipe lines may permanently supplant rail movement of both crude oil and gasoline to some sections of the Eastern states.

Some program of pooling of facilities and the pooling of extra costs is necessary for petroleum refiners in order fully to utilize idle tank cars. Obviously no single refiner dares accept the railroad's proposals for extensive rail movement at the prospective large increase in cost. However, all the refiners appear quite willing to use every rail facility which can be made available if a distribution of the increased cost over all gasoline, not only the gasoline of cooperating companies, can be arranged. Obviously any "deals" to provide such pooling of extra expense involve difficult questions as to violation of the anti-trust laws. Whether Mr. Ickes will persuade Assistant Attorney General Arnold to collaborate remains an official secret early in September.

Extensive cooperation in financing of new pipe lines has, however, been assured. And Presidential blessing under the new law has been given to two such projects. Prompt construction is expected through the ability to secure rights of way under Federal eminent domain procedures.

Not the least of the official troubles is the difficulty of getting filling station operators to cooperate in price restriction. Several warnings, including specific price recommendations from O.P.A., have been rather conspicuously ignored in various districts. Better success has been had by Mr. Henderson's office in securing compliance with crude oil price limits which were recommended toward the end of August.

Very strong pressure is being brought to bear on all industry to substitute

coal for petroleum in firing industrial furnaces wherever possible. However, the only official effort to make this change not too expensive is the recent attempt by Bituminous Coal Division of Interior Department to put a maximum price on bituminous coal in the few cases where runaway prices seemed to approach full-scale profiteering.

Munitions Plants

The first of the smokeless powder works of the Army's second chain of munitions plants was announced for Choteau, Okla., last month. This is the initial powder factory to be located west of the Mississippi. Funds allocated for construction and equipment were $51,000,000, which will provide a plant about as large as that going up at Childersburg, Ala., and considerably larger than the one at Radford, Va.

Another new plant location announced by the Army is for a bag loading establishment at Flora, Miss., to cost up to $14,500,000, to handle the product turned out at Childersburg. Other developments in the munitions plant program were largely the letting of contracts and subcontracts for units previously announced.

The Chattanooga, Tenn., TNT-DNT-Tetryl production job was given to the Hercules Powder Co. Stone and Webster will build and equip the plant with a subcontract for $34,245,732. Ammunition and shell loading assemblies at St. Paul and Salt Lake both were put under contract and an additional $1,720,267 was allotted for the Western Cartridge-operated small arms plants at St. Louis.

Operation of the St. Paul plant was awarded to Federal Cartridge Co., and sub-contract for construction was given to Foley Brothers, Inc., and Wallbridge-Aldinger Co. Construction cost is listed at $17,661,925 while the operating firm was given $12,824,075 more with which to equip the assembly. Remington Arms Co., Inc., will operate the Salt Lake plant where ball, armor-piercing and tracer ammunition will be assembled. Cost of this plant is $30,485,000.

After first awarding contract for a $5,000,000 ordnance regulation station in Illinois to provide a routing headquarters for shell and ammunition components, the Army cancelled plans. Instead additional funds were alloted for storage facilities at three previously established loading plants. The Ravenna plant gets $977,500; the Wilmington, Ill., $825,000; and Burlington, Iowa, $562,000.

A contract for construction of the Commercial Solvents-operated ammonia plant at Monroe, La., was awarded to the M. W. Kellogg Co., New York City. The construction cost is estimated at $6,557,086. Commercial Solvents previously has been given $9,252,911 to equip this plant.

Laboratory Supplies

Laboratories engaged in scientific research were given a blanket priority rating of A-2 for all needed supplies of critical materials by action of OPM's Priorities Division at the end of August. The rating is automatic, once certain formalities are compiled with, and can be extended through suppliers and sub-suppliers by a participating laboratory as far as necessary to assure ultimate delivery of scarce materials.

Application for use of the A-2 rating must be made to the Chemical Section of OPM headed by Dr. E. R. Weidlein, on Form PD-38. The application must specify that the laboratory is seeking certification to use the Research Laboratories Supplies Plan and state the branch of scientific research in which the laboratory is engaged. OPM announces that it will have the benefit of advice from the National Academy of Sciences in passing upon all applications received.

Once certification is obtained, the laboratory must serve copies of the order, bearing an individual serial number, upon all its suppliers. In its original application, laboratories should state the number of suppliers' copies of the certification it will need.

The A-2 rating is not to be used to obtain materials which can be procured without it, nor can it be used for accumulating materials over and above those actually needed or in advance of need. Both laboratories and suppliers are obliged to maintain records of the use of the A-2 rating for periodic inspection by OPM's field and compliance staff.

Chemical Miscellany

Cotton Linters—Elaborate regulations limit both the way in which linters may be cut and the marketing of this product. Sales of certain types are restricted to purposes in the chemical industry in order to avoid shortage of this essential raw material for plastics and explosives manufacture. The Bureau of Agricultural Chemistry and Engineering is also pushing its research on a process to convert staple cotton into linters by a mill which "operates like a giant lawn mower and cuts batts of cotton four inches thick at the rate of 2400 cuts a minute, or two tons of cotton an hour." The resulting product is then further milled down to the proper length for nitration to permit effective handling by the explosives and plastics manufacturer.

Vegetable Drying—New chemical engineering technics are being developed for dehydration of vegetables and fruits. It is important thus to reduce bulk and weight of foods of this sort. The immediate purpose is to provide emergency reserve stocks at remote bases, such as Iceland, and to supply the British with desired raw materials with the minimum cost for transport. Department of Agriculture studies are being carried out at the Western Regional Research Laboratory where investigations are being done on onions, potatoes, carrots, and certain green and leafy vegetables. Thus far government purchases of dehydrated foods have been largely limited to dehydrated soups.

Export Control—Virtually every commodity, certainly every chemical, is now subject to license for export. Thus far import controls have not been established, but that is to be expected as part of the job of Vice-President Wallace and his economic warfare Board.

Mercury Price—OPACS administrator Henderson has issued several private and one emphatic public warning about the quoted prices for mercury, currently $192 per flask in mid-August. Since U. S. production is a trifle greater than current consumption, and Mexican production is also available, "there is no reason for any private buyer to pay present prices," according to Dr. Henderson. The price to be officially fixed was not announced during August, but it was confidently expected that it would be well under the recent high.

Priority Racketeers—Official Washington is warning manufacturing industries against certain market racketeers who grossly misstate distribution problems in an effort to get control of goods. One practice is specifically condemned by officials. This is the claim by marketers that they are helping to supply needed goods on Defense projects when they are merely trying to persuade manufacturers to give them some goods which they intend to resell at an abnormal markup. O. P. A. would like to have any evidence which is available regarding this high-jacking. Disciplinary actions will follow.

Pulp Shortage—Probably the most serious factor confronting the paper products industries currently is the shortage of raw material for pulp board. A strenuous campaign for collection of waste paper is being undertaken. All this reflects a tremendous increase in consumption of cartons for defense. Much of this increase as now experienced may terminate with the emergency. But the new types of containers which have been devised promise tremendous new packaging possibilities for food, chemicals, and industrial goods of all sorts. It looks as though this division of the paper products business had established through emergency stimulus a basis for a several-fold permanent increase in the business of packaging America's peacetime products.

Tariff Cuts—Certain Washington executives, claiming emergency need, have urged that government departments be allowed to exempt imports from tariffs in order to economize for defense. Critics argue that this does no good as collecting a duty through one channel for the Treasury fully offsets apparent greater cost to the defense agency making the purchase.

DEFENSE PROBLEMS WILL KEYNOTE CHEMICAL EXPOSITION

New achievements in America's march toward economic independence will highlight the 18th Exposition of Chemical Industries, coming to Grand Central Palace, New York, Dec. 1-6. The display will be the largest Chemical Exposition in twelve years. Applications are still being received from prospective exhibitors, although practically all the available space was allotted more than a month ago. Problems of national defense will be the keynote, but underlying this theme will be a very large amount of evidence pointing out the nation's strategic advance toward self-sufficiency.

According to Charles F. Roth, manager of the Exposition, no Declaration of Independence was needed to rally the forces of American industry to the cause of economic freedom, because industrial enterprise is self-inductive. However, circumstances involved in the present world emergency have greatly accelerated the movement and given it widespread recognition.

Information on exhibitor's plans reflects the important task which chemical engineering has assumed in this war. Already its achievements have broken many shackles which formerly bound American manufacturers to the use of imported raw materials and manufactured products, and have superseded processes formerly under alien control. Chemical process industries, which got their start in the last world war, have become one of the principal ingredients in the new defense program. The Exposition will strikingly emphasize their progress. More than that, it will reveal many interesting forecasts of the post-war future.

Significant facts which many of the exhibits will reflect bear out the following points: Partly chemical industries are becoming more chemical. Non-chemical industries are consuming more chemical products and adopting chemical methods. Artificial materials are rapidly replacing natural products. Synthetics, so much in the foreground just now, are no longer regarded merely as substitutes, but as new competitive materials. Many of them are literally created for specific purposes and serve those purposes better than the conventional materials they replace. From laboratories and pilot plants not merely new products but whole new industries are coming forth. One of the characteristics of the times is the evolution and marketing of new processes and equipment in the form of complete operative units.

Among the exhibitors will be a number of specialists in industrial development work, who will offer such completely integrated facilities as: acid plants, extraction plants, food industries equipment, paint making machinery, rayon equipment and the machinery for turning out various products in plastic materials.

The 18th Exposition of Chemical Industries will comprise as a whole exhibits reflecting the rapid advance of chemical technology in general and also raw materials, machinery and products of process industries.

REGULATIONS FOR TRANSPORTING EXPLOSIVES TO BE SIMPLIFIED

Regulations for the transportation of explosives and other dangerous articles by motor vehicles are to be revised and simplified. This is occasioned by the transfer of enforcement of these motor vehicle regulations from the ICC Bureau of Motor Vehicles to the Bureau of Service. Revision in the present regulations, known as Part 7 of Motor Carrier Safety Regulations, will bring rules covering all forms of land transportation of these materials into harmony, under the jurisdiction of those long familiar with rail transportation of explosives.

The proposed regulations will be considered at a public hearing on September 18 at the Washington office of the Interstate Commerce Commission. At the same time slight revisions in the general regulations for transportation of explosives will also be considered. The Manufacturing Chemists' Association and other trade associations are cooperating with ICC officials in making the change to new regulations with a minimum of technical difficulty. Those interested in details may obtain mimeographed copies of the proposed regulations prior to promulgation.

CANADIAN PATENT FOR MAKING ALCOHOL FROM APPLES

A process for making 100 percent alcohol, as explained by W. D. Fleet of Vancouver, B. C., an electrical engineer who holds the patent, is extremely simple and could be employed to produce a low cost product which Canada is at present importing for various important uses, some of them connected directly with war industries. Recently the national chemurgic committee of the Canadian Chamber of Commerce recommended that the government install an experimental plant for production of power fuel from wheat. This committee suggested that a government subsidy would be required as the cost was bound to be greater than the cost of gasoline. The object of the proposal was to ease two of Canada's problems by reducing the wheat surplus and at the same time reducing imports of crude oil and gasoline. It was reported that Australia has launched fuel alcohol production from wheat.

Mr. Fleet's view is that more valuable products can be made from wheat than alcohol. He carried out some investigations along these lines some years ago, but came to the conclusion that farmers, raising wheat as an industry, are the ones to subscribe to a fund for research work to find uses for grains other than foodstuffs.

MODERN METALS AND PLASTICS ON N. Y. U. LECTURE SCHEDULE

In order to assist industries in meeting some of the problems created by the national defense program, New York University has scheduled a series of fifteen weekly lectures on modern metals and plastics to begin Sept. 23. In these lectures experts will discuss ways in which the more available materials may be substituted for others which have become more difficult to obtain.

W. L. Merrill, head of the works laboratory of the General Electric Co., will deliver the opening lecture in the series. Other speakers will include Milton Male, research engineer of the United States Steel Corp.; F. L. LaQue and J. W. Sands of the International Nickel Co.; N. E. Woldman, chief metallurgical engineer of the Eclipse aviation division of the Bendix Aviation Corp.; R. V. Boyer of the plastic division of the General Electric Co.; and C. T. O'Connor, head of the oil soluble division of Durez Plastics and Chemicals, Inc.

MINERALS YEARBOOK FOR 1940 NOW AVAILABLE

In response to unprecedented demand for comprehensive information on metals, nonmetals, fuels, and mineral products, from the mineral industries and from government defense agencies, the Bureau of Mines has scheduled publication of its Minerals Yearbook more than three months in advance of last year's date. The current edition of Minerals Yearbook, containing the most inclusive collection of facts and statistics on mineral industries ever assembled, was placed on sale by the Superintendent of Documents early in September.

PILOT PLANT TO MAKE MOTOR FUELS FROM FARM PRODUCTS

A semi-commercial plant for production of motor fuel from farm products has been practically completed at the U. S. Department of Agriculture's Northern Regional Research Laboratory at Peoria, Ill. This so-called pilot plant, into which the chemists and engineers have incorporated all the latest improvements in equipment and processes available, is to be used for rigorous, large-scale testing of promising developments from the Regional Laboratory and elsewhere, and is capable of producing 500 gallons of alcohol per day.

Not only will the Northern Laboratory study the ways of manufacture of these special motor fuels, but will also study performance of the fuels in engines. The usual laboratory work will be continued in an effort to develop new fundamental facts in the production and use of alcohol and other materials with motor fuel possibilities. At Peoria the first pilot plant work will be on corn, followed by work on sweetpotatoes, white potatoes, wheat and other carbohydrate crops.

HEAVY DEMAND FOR CHEMICALS IN GREAT BRITAIN STIMULATES DEVELOPMENT OF NEW PRODUCTS

Special Correspondence

Demands and supplies remain on a heavy scale for all industrial chemicals, but further price advances were mostly avoided in spite of the continued scarcity of such articles as yellow prussiate of potash. The market tone remains strong, especially for copper sulphate, acetic acid, zinc oxide, hydrochloric acid, calcium chloride and formaldehyde, and the available supplies of these and other manufactures move steadily into home consumption. In the group of fine chemicals and pharmaceuticals occasional irregularities have been soon overcome, and recent developments suggest a lasting improvement. The output of coal-tar products is on a very substantial scale, but supplies of all liquid byproducts, with the insignificant exception of pyridine, are only just sufficient to meet demands. There is, however, a considerable surplus of pitch, while some of the heavier products are available in quantities permitting continuation of the export business. Exports are also of some importance in the paint group, while the supply of fertilisers is generally not more than adequate for home demands. Superphosphates will be supplied in higher concentrations next season in continuance of a tendency observed during recent years. As the normal grade on the British market will contain 19.2 percent of phosphoric acid (against 16 percent last season), farmers are advised to reduce the per-acre application. Potash salts are in short supply, owing to the loss of Continental supplies, and must not be used except for certain crops and for these only in limited quantities. Supplies of nitrogenous fertilisers are ample, but the demand for these has also been raised by the extension of land under cultivation by 4,000,000 acres.

Research on the action of tar-oils on coal carried out in the Mining Department of the University of Birmingham has resulted in the production of tar-oil coal extracts which lend themselves to a variety of promising applications. Practically ashless materials were recovered from the solutions into which the coals under examination passed when extracted with neutral tar-oils at their boiling points (up to 400° C) under atmospheric pressure. These coal extracts might be used to improve the caking and swelling properties of non-caking coals, as a binding agent in the manufacture of briquettes, for the production of colloidal fuels, in order to modify the properties of ordinary coal-tar, etc. They may be treated further to yield a pitch-like material containing no free carbon, a hard pitch for pulverization and use in coal-dust engines, special low-ash carbon (or even graphite) or pure compounds of value in chemotherapy.

The experiments at Birmingham University have not yet been concluded and no information is available of their industrial merits, but they confirm a tendency observed in British fuel chemistry before the war, and intensified since, to regard coal as a raw material which must be treated further in order to give the greatest economic service. This tendency has been strengthened by increased utility of certain byproducts obtained by the treatment of coal, on the one hand, and the need of economy in the consumption of coal during wartime, on the other.

With a view to meeting the demand for a substitute for iron oxide which is normally used in the purification of gas, a leading chemical producer has undertaken experiments with sulphur bacteria such as are almost invariably present in peat. These, it is stated, can be used very effectively for the oxidation of hydrogen sulphide to sulphur if the correct conditions for their activity are observed. A mixture of equal volume parts of peat and low-grade spent oxide has been used at one plant for many months with very satisfactory results. The water gas is purified to the degree required for subsequent processes, there has been no development of excessive pressure drop, the purchase of new oxide has been much reduced, and the low-grade spent oxide —previously dumped as valueless—is converted into a readily saleable material of high sulphur content. Addition of more fresh peat to this spent oxide-peat mixture produces a mass as good in activity and sulphur removal capacity as the original mixture and resulting in a finally spent mass of yet higher sulphur content. The experiments must, however, be continued, before a final judgment can be passed on their suitability for large-scale purification of town gas.

A new synthetic material for industrial components was shown at an exhibition of the Society of British Aircraft Constructors. It is a cellulose fiber material bonded with special type adhesives on the laminated principle and possesses a density of 48 lb. per cu. ft., specific gravity of 0.77, tensile strength of 3,900 lb. per sq. in. and high damping properties. Many of the characteristics of metal and light alloys are claimed for the material, though it is much less likely to suffer accidental denting and other impact damage. The moisture resistance is stated to be adequate for most purposes and conductivity nil. The original strength and fiber orientation of the material are retained and give it, in fatigue under vibration, qualities superior to other materials commonly used.

Luminescent and phosphorescent materials are of considerable importance for use under black-out conditions. The most commonly employed phosphorescent materials are zinc and zinc-cadmium sulphides and alkali earth sulphides, according to an exhaustive report of the Ministry of Home Security. With proper selection of materials, good durability can be obtained. Shielding from direct sunlight is generally desirable, otherwise darkening may occur, although it will not necessarily be permanent. Luminescent signs having a long life may be prepared by incorporating zinc sulphide in a vitreous enamel before firing. Alakaline earth sulphides exhibit lower initial brightness and longer afterglow. Calcium sulphides have good stability, but the commercially available material gives a deep violet glow to which the eye is relatively insentitive. Strontium sulphides have been largely used for luminescent paints because of their easily visible blue-green glow, but need special protection, preferably by enclosure between two sheets of glass with waterproofed edges, as they are unstable. None of the materials so far available, however, can be relied upon to remain usefully visible throughout a winter night after excitation by daylight. After a period of 6-7 hours they are indeed inferior in visibility to normal white paint.

Chemicals new and old play an important part in the solution of special wartime problems experienced by British textile finishing firms. One of the most outstanding developments has been in water-proofing. The government specifications in this field may be divided into two classes, those calling for a durable finish free from wax and possessing high repelling power and those which can be met by the use of a wax aluminum salt finish. Sewn seams of strongly waxed or oiled fabrics are generally dressed with a synthetic resin. For rot-proofing (of sandbags, etc.) the use of metallic naphthenates which require to be supplied from organic solvents with consequent file hazard and expense have been followed by the introduction of aqueous dispersions of suitable metallic naphthenates. For blackout cloths thermoplastic resins have been found in many cases to possess excellent binding power for pigments, while the addition of a water-soluble cellulose ether derivative gives body to the finish. A satisfactory transparent window replacement fabric of filled cotton or net type is obtained by stiffening with starch or glue, immersion in a translucent resin solution and, finally, passage up a drying tower.

The Safety in Mines Research Board refers in its latest annual report to experimental work that has been in progress for some time on a test to distinguish between explosives which can and those which cannot be improved to a satisfactory extent by sheathing. No explosive of any economic value has yet been produced which, with or without a sheath of reasonable dimensions, will not ignite firedamp in some circumstances and more effective sheating is sought.

MONSANTO *Plasticizers* FOR USE WITH VARIOUS RESINS AND PLASTICS

	TRICRESYL PHOSPHATE	TRIPHENYL PHOSPHATE	SANTICIZER 8	SANTICIZER 9	SANTICIZER 10	SANTICIZER B-16	SANTICIZER E-15	SANTICIZER M-17	DIBUTYL PHTHALATE	DIETHYL PHTHALATE	DIMETHYL PHTHALATE	DIPHENYL PHTHALATE	AROCLORS
NITROCELLULOSE	X	X	X	X	X	X	X	X	X			X	X
CELLULOSE ACETATE		X	X			X	X	X		X	X		
CELLULOSE ACETOPROPRIONATE	X	X	X			X	X	X	X				
CELLULOSE ACETOBUTYRATE	X	X	X	X	X	X	X	X	X				
ETHYL CELLULOSE	X	X	X	X		X	X	X	X			X	X
CHLORINATED RUBBER	X					X	X	X	X				X
SYNTHETIC RUBBER*	X	X				X	X	X	X				X
POLYVINYL ACETATE	X			X	X	X	X	X	X			X	X
POLYVINYL CHLORIDE	X	X				X	X	X	X				
POLYVINYL ACETALS			X			X	X	X	X			X	
POLYSTYRENE	X					X	X	X	X			X	X
PHENOL-FORMALDEHYDE RESIN	X							X					
UREA-FORMALDEHYDE RESIN				X									
PROTEIN COMPOUNDS			X										
SHELLAC			X	X	X	X	X						
DAMAR	X					X	X			X			
MANILLA GUM						X	X			X			

X denotes—of use

X denotes—of special value

*The use of plasticizers in synthetic rubbers is still in development stage. The kind of synthetic rubber and the use for which it is intended will govern the selection of the plasticizer. The plasticizers indicated have shown promising properties in test formulations.

From this list of proven, high-quality Monsanto plasticizers you should be able to fill almost any need. Here are familiar standard products, as well as special ones developed to fit new requirements. For complete descriptions of the entire list and many helpful notes on their applications, write today for the 40-page book, *Plasticizers and Resins.* You will find it a useful, practical reference that may save many hours of testing in your own laboratories.

MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, St. Louis, U. S. A. District Offices: New York, Chicago, Boston, Detroit, Charlotte, Birmingham, Los Angeles, San Francisco, Montreal.

LET'S GO! U.S.A. KEEP 'EM FLYING!

MONSANTO CHEMICALS

SERVING INDUSTRY... WHICH SERVES MANKIND

REICH PLANS REORGANIZATION OF EUROPE'S CHEMICAL INDUSTRY TO ACHIEVE SELF-SUFFICIENCY

Special Correspondence

CHEMICAL self-sufficiency for Europe is the goal announced by I. G. Farben, Germany's leading chemical concern. Under the "New Order"—which presupposes Nazi victory—plans call for complete continental reorganization of the industry, including building of new plants in areas best suited by reason of location of raw materials or cheap power or labor. Because of the abundance of hydroelectric power, plants using chemical processes requiring large amounts of electricity would be located in Scandinavian countries. Norway could thus supply synthetic fertilizers to France, Spain, and the Balkans. In return, France could send bauxite needed for aluminum to Norway. Yugoslavia, able to build an electrochemical industry on the basis of available water power and labor, would become the center of the Balkan chemical industry with Bulgaria and other Balkan countries supplying raw materials. In Rumania a specialized chemical branch would be built around the mineral and vegetable oils found there.

In France, bauxite deposits would be developed further, and the present well-organized organic chemical industry would be expanded. Swiss rivers, also a source of power for electrochemical industries, would be fully utilized. In the past, Switzerland has imported practically all its chemical raw materials, chiefly from Germany, France, and Belgium, while it has exported 95 percent of its total output. Switzerland as well as Italy suffers most from lack of coal, and this along with heavy industries would remain under German control. Italy, which has a fairly well-developed electrochemical industry would be an important producer and would at the same time contribute mercury and sulphur to the other countries, while Spain would supply pyrites.

These plans, which would also require syndicates for the organization and distribution of production, have already been partially put into effect. For example, a new company, the Nordische Aluminium A. G., was recently organized in Berlin with a capital of 20 million RM for the production of aluminum and alloys in Norway. In the past, Norwegian aluminum industry has been largely American- and British-financed. Norway also has a fair-sized ferro alloy and nitrate industry. The expansion of Norway's industries would be necessary to offset the country's meager agricultural output and wartime dislocations which have virtually cut off Scandinavia from British and overseas markets. In normal times Norway depends largely on the earnings of her merchant marine, the fourth largest in the world, her whaling fleet, and seashore fisheries. At the time Norway was overrun, five-sixths of her merchant fleet was outside Norwegian ports and is now run by the Royal Norwegian government in London. Germany has been taking increased quantities of Norwegian fish—the Norwegian fishing industry has been assigned an important role in feeding the continent under the "new order"—wood pulp, paper, lumber, and mineral products. Norway has iron ore and smaller deposits of sulphur, pyrites, nickel, and copper, but no mineral fuels. For these she is dependent now on Germany, which is providing her with coal as well as with chemicals, synthetic textiles, machinery, and electro-technical articles. Although sufficient potatoes and oats can be raised domestically, in the past, Norway has had to import wheat, rye, corn, barley, rice, sugar, oil seeds, meats, and cattle fodder. Under German supervision, Norway has concluded agreements on a clearing basis with other countries also within the blockade, chiefly with Denmark and Sweden.

Sweden, placed in an unenviable position by the blockade as well as by her position between Germany and the Soviet Union, would probably be invited to participate in the "new order," her specialties being match production as well as an electrochemical industry. In Sweden a new sulphuric acid factory with a capacity of 20,000 tons is about to be placed in operation. This is partly in connection with the first state-guaranteed wood sugarization company in Sweden which is to set up two plants with an annual 3 and 5 million liter alcohol output. Sweden is also trying to develop its shale oil deposits. The A. G. Vorjag with an intended yearly capacity of 7,500 tons is building a plant for this purpose.

Denmark, also suffering badly from blockade, is finding it difficult to supply chemical factories with raw materials. To replace imports, a Danish sulphuric acid and superphosphate company is producing crude carbolic acid in connection with coal tar distillation. Formerly Danish tar production, largely in gas works, exceeded the demand, but now finds a ready market due to the extensive road building projects in Denmark encouraged by the German military authorities. Recently a new tar emulsion was developed as a road covering.

The position to be occupied in the "new order," of France, Belgium, and Holland, is not entirely clear. On the one hand, these countries have well-developed industries and a skilled laboring class. They are included in recently-formed continental European rayon, iron, steel, and synthetic fertilizer syndicates under German leader-

ship. On the other hand, partly because the location of these countries leaves them vulnerable to air raids, partly because strong industries would help them equip armies, and partly because western European soil and climate render crop yields larger than in eastern Europe, there has been discussion of making these countries agricultural centers and shifting industrial production centers inland where they would be less vulnerable, and where a cheaper and more docile labor supply would be available. There is no way of knowing how many plants in these countries have actually been dismantled and machinery and parts shipped to Germany or other areas. It may be that the capacity in southeastern Europe is intended to be chiefly new industries to supplement those already in western Europe.

Hungary, where chemicals form only 6 percent of total industrial output, imports one-fourth its chemical requirements and its entire supply of coal-tar dyes and rayon. It would apparently remain largely a raw material producer, chiefly of foodstuffs. It has some textile and metal industries, but its role would be more that of a producer of products such as soy beans and drugs and medicinal herbs.

Bulgaria's chemical industry is only 15 years old. Its output is 8 percent of industrial production. Its exports consists chiefly of specialties such as rose and mint oils, crude drugs, and glycerine. Bulgarian rose essence, distilled largely under state control, is reported to supply 80 percent of the annual world consumption of 3,000 kg. Since the outbreak of the war, Bulgaria has been trying to build up basic chemicals for local industries as well as to supply its army. A carbon bisulphide plant, the first of its kind in Bulgaria, is to be erected soon with participation of an I. G. subsidiary, "Deutsche Anilin-Farben Weibel & Co." This firm recently acquired a Jewish-owned lacquer factory, Iskevitsch and Levy, in Rutschuk, Bulgaria.

In addition to exploiting Rumanian mineral oil, estimated around 6 million tons per year, the acreage planted in cotton is expected to be doubled from 50,000 to 100,000 acres, that of flax increased to 200,000 acres, of castor beans to 2,500 acres, and of sunflowers to 800,000 acres.

Simultaneously with these plans, strenuous efforts are made to overcome transport difficulties. The Danube has been regulated so that ships of 1,000 to 1,200 tons can be operated even at low water. River ports at Vienna, Regensburg, Linz, and Krems have been modernized and expanded. The Danube is also being incorporated into the extensive canal network planned for the continent. Already under construction is a canal connecting the Danube and Oder, which, when ompleted, will give a continuous waterway of 2,600 km. between Stettin and the Black Sea.

READERS' VIEWS AND COMMENTS

Readers are invited to express their views on articles appearing in Chem. & Met. *or on other subjects of interest to chemical engineers. As far as our space permits such views and comments will be published in these columns. Address your letter to the Editor of* Chem. & Met., *330 West 42 St., New York, N. Y.*

KEEP US LITTLE FELLOWS IN BUSINESS!

To the Editor of Chem. & Met.:

Sir:—On Page 120 of the August issue, I read: "The . . . . should stop their present buying practice." Are you naive or are you asleep? The bootleggers keep little fellows like us in business and I pray they may continue to "prey" on me.

If you ask the candid opinion of "little fellows" you may learn that we consider this emergency a gift from Heaven for the "big fellows" who don't want us in business in the first place no matter how legitimate we are. At the first appearance of scarcity of a common and available chemical, the supplier shuts down on us. When I told him I could get all I wanted second-hand, and that his company had an obligation to a two-drum a month non-contract buyer for two years past, he only shrugged his shoulders. (Name and incident furnished on request.)

It's well known that one may not enter an equity court with unclean hands. Let the "big fellows" in the chemical business (with one exception to my knowledge) wash their hands and stop the criticism appearing on Page 120.

J.B.S.

Note: In our August issue we deplored the bootlegging tactics which might give an erroneous impression regarding the course of chemical prices. The writer of this letter has raised the question, what is the small manufacturer to do when he is confronted with the dilemma either of buying bootlegged chemicals at exorbitant prices or of closing his plant because of lack of raw materials?—Editor.

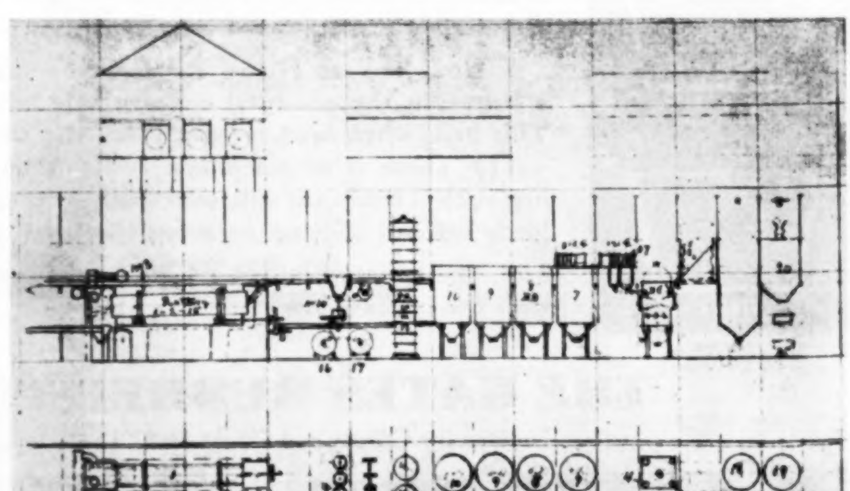
ALUMINA PRODUCTION, 1892

To the Editor of Chem. & Met.:

Sir:—An article on aluminum in the *New York Times Magazine* for July 20 by Frank S. Adams failed to give credit to the engineers of the Solvay Process Co., who, in the beginning of 1892, designed, built and operated a plant for the manufacture of pure alumina from bauxite. The article did give credit for the process used by the Aluminum Company of America for the conversion of bauxite into pure aluminum oxide, to Karl Joseph Bayer. This is correct, as far as the process which was adapted by that company about 1895, but I would like to call your attention to the earlier process.

The process which was used by the Solvay Process Co. in Syracuse was designed, built and operated by the writer as chief engineer of that company. It was a furnace process which was able to use bauxite having as high as 20 percent silica, whereas the Bayer

Below is a reproduction of a blueprint which Mr. Trump sent with his letter. Dated June 1, 1892, it is a diagram of the alumina plant which Solvay built at Syracuse, N. Y.



process is limited to 5 or 6 percent. Arkansas is the only place in the United States where limited quantity of this percentage is found. There are many other deposits in the country, however, where bauxite of 15 to 20 percent is found, the use of which will eliminate the high cost of transportation of the low silica bauxite now imported from British Guiana. Nearly 50 large steamers are used in the transportation of this bauxite to Mobile, Ala. and up the Mississippi River to East St. Louis, from which plants the pure alumina is transported to Alcoa, Tenn., to Massena, N. Y. or sent overland to the new Alcoa plant at Vancouver, Wash.

The writer is consulting engineer for the Reynolds Metals Co. and designed alumina plants which have been built at Sheffield. I write this because the credit for the purification of bauxite to make alumina should be given to the Solvay Process Co. as their chemists and engineers were three years ahead of Bayer. He used a digestion process for which a very low silica bauxite is slightly less expensive than the furnace process.

The accompanying copy of a sketch made by the writer in 1892 shows the plant which was used to made the first alumina.

EDWARD N. TRUMP
Chemical Engineer
Syracuse, N. Y.

AMERICAN PRACTICE

To the Editor of Chem. & Met.:

Sir:—Reference is made to the importance and necessity of aeration to eliminate the effect of ozone in the process of irradiating milk to increase its vitamin D potency in an abstract of an article entitled "Engineering Aspects of Milk Irradiation" by W. Diemair (*Chemische Fabrik* **14**, 51, 1941), which appeared on page 143 of the July 1941 issue of *Chemical & Metallurgical Engineering*.

To avoid any confusion in the minds of those interested in milk irradiation in this country, it is well to point out the fact that ozone presents no problem if a carbon arc is used. It is, therefore, not necessary to apply aeration when milk is irradiated in the irradiators developed by National Carbon Co. in which the carbon arc is used as the source of ultra-violet. It has been conclusively demonstrated ("Gases From Carbon Arcs: Absence of Ozone," by R. W. Coltman and H. G. McPherson, *Journal of Industrial Hygiene and Toxicology*, Sept. 1938) that no ozone is associated with the operation of carbon arcs. A Vitamin D potency of 400 units per quart with unimpaired flavor is being obtained at a flow rate of 10,000 lb. per hr. through the National irradiators widely used in this country for irradiating both fluid and evaporated milk.

A. BROGGINI
National Carbon Co., Inc.
Carbon Sales Division,
Cleveland, Ohio

PERSONALITIES

Lawrence E. Stout

✦ Lawrence E. Stout, contrary to the statement made in the August issue of *Chem. & Met.* in connection with the promotion of Prof. Jules Bebie, continues as head of the department of chemical engineering, Washington University, St. Louis. Professor Stout has been in charge of the department since chemical engineering was set up as an independent department a year ago.

✦ Fred H. Haggerson has been elected a director of the Union Carbide and Carbon Corp. Mr. Haggerson is a vice-president of Union Carbide and Carbon Corp., president of Union Carbide Co. and president of the companies in the Electro-Metallurgical group. He has been with the corporation for more than 20 years.

✦ R. N. McAdams, assistant secretary and assistant treasurer of Hercules Powder Co. has been elected secretary of the company. He fills the vacancy created by the death of Mr. H. F. Smith. George B. Baylis who has been connected with the treasurer's office of the Hercules Powder Co., has been elected assistant secretary of the company. Mr. Baylis joined the company in 1918 and has been employed in the chemical department, the high explosives operating department and the credit and accounting departments. He was for a number of years secretary to Mr. Charles A. Higgins, president.

✦ Kenneth A. Kobe, associate professor of chemical engineering at the University of Washington, has resigned in order to assume the duties of professor of chemical engineering at the University of Texas, Austin. After obtaining his doctorate at the University of Minnesota in 1930, Dr. Kobe had a year of industrial experience before joining the staff of the University of Washington.

✦ Douglas M. Considine has resigned from D. W. Haering & Co., Chicago, to accept a position as technical writer for the Brown Instrument Co., Philadelphia.

✦ Mathew M. Braidech, associate professor of chemical engineering at Case School of Applied Science, was elected chairman of the water purification division of American Water Works Association at its recent convention. Professor Braidech was chairman of the committee on activated carbon research for the past five years and is also chairman of the committee on specifications and tests for water purification chemicals. In 1936 he was the recipient of the John Goodell prize for outstanding contributions to the science of water purification.

✦ W. N. Williams and J. Rivers Adams of the Westvaco Chlorine Products Corp. have recently been promoted. Mr. Williams has been advanced from manager of sales to assistant to the president, while Mr. Adams has advanced to the position of manager of sales.

✦ E. L. Luaces, chemical and patent consultant has moved his office from New York to Dayton, Ohio, where he will be associated with Toulmin & Toulmin, patent lawyers, in the preparation and prosecution of patent matters in the fields of chemistry and chemical engineering.

✦ J. B. Warner has established in Chattanooga, Tenn., the Sanoray Laboratory. Mr. Warner was formerly with Southern Chemical, Research & Sales Co., associated with W. F. Lamoreaux.

✦ F. G. Gardner of the engineering staff of Kellogg Switchboard & Supply Co., has been selected to fill the position of acting chief engineer.

✦ Robert B. Whyte has been elected vice president in charge of operations for the Macwhyte Wire Rope Co. He has been general superintendent of the company.

✦ B. J. Larpenter, Atlantic District Manager of Dorr Co. since 1936, is being transferred to company headquarters in New York where he will be in charge of metallurgical development work. Replacing Mr. Larpenter in Atlanta is D. W. Heneger, who has been connected with the chemical sales staff in New York. Change was effective September 1.

✦ E. E. Wark, vice president of the Sherwin-Williams Co., who for many years has been technical adviser to the president, will be in charge of operations of the new ordnance plant to be built on Crab Orchard Lake at Marion, Ill. The Sherwin-Williams Co. will have charge of construction, management and operation for the government of the huge bomb and shell loading plant known as Illinois Ordnance Works.

✦ C. C. Brownley has been added to the sales staff of Milby-McKinney, Baltimore, Md. Mr. Brownley is a graduate of Johns-Hopkins School of Engineering.

✦ F. Cecil Baker has been elected president of the American Potash & Chemical Corp. He succeeds H. S. Emlaw who resigned but will continue as director and a member of the executive committee. Mr. Baker has been manager of the American interests of the Consolidated Gold Fields of South Africa, Ltd., and a vice president of American Potash & Chemical for many years.

✦ Russell W. Mumford has been elected vice president and consulting chemical engineer of the American Potash & Chemical Corp. Dr. Mumford has been with the company since 1920 and has been responsible for many of the company's engineering developments.

✦ John R. Matchett, chemist of the Bureau of Narcotics, has resigned according to a recent announcement by the Treasury Department. He has been transferred to the Department of Agriculture. His new field will be the research laboratory at Albany, Calif. A native of Indiana, he is a graduate of Purdue and Chicago Universities.

✦ Elmer W. Pehrson has been appointed chief of the economics and statistics branch, Bureau of Mines, according to Dr. R. R. Sayers, director of the Bureau. Mr. Pehrson, a mining engineer and economist, has been acting head of the economics and statistics branch since the retirement of James W. Furness in May, 1940, and as chief of the branch will continue to direct for the Bureau, the collection, compilation, collation, interpretation and publication of statistics and data on minerals, mineral products and the mineral industries.

✦ Karl A. Folkers, assistant director of research in the Merck Laboratories, Rahway, N. J., has been awarded the $1,000 American Chemical Society prize

in pure chemistry for 1941. Presentation of the award, given annually for outstanding research in pure chemistry by a man or woman less than 36 years old, took place at the recent Atlantic City meeting of the Society. Dr. Folkers was chosen in recognition of his contributions in the field of organic chemistry.

✦ FRANK SHERRY, who recently graduated from the Rensselaer Polytechnic Institute, Troy, N. Y., is at the present time in the technical training division of the B. F. Goodrich Co., Akron, Ohio.

✦ J. E. GULICK has been named factory manager of the Los Angeles division of the B. F. Goodrich Co., succeeding Joseph C. Herbert, assistant secretary of the Lone Star Defense Corp., a subsidiary of the Goodrich company, which will construct and operate the government ordnance plant in Texas. Fred A. Nied succeeds Mr. Gulick as manager of the inter-plant operations department. Frank Trockle is named acting general superintendent of Mill 4, succeeding Arthur Kelly, who becomes general manager of the Defense corporation of Texas. L. K. Starkweather assumes Mr. Trockle's duties as production superintendent of Mill 4.

✦ DONALD B. STEWART has been named general manager of the general chemical laboratories of the B. F. Goodrich Co., succeeding Dr. Victor E. Wellman, who has been appointed technical assistant in the general factory administrative department, a new post, it is announced by J. W. Schade, director of research. Mr. Stewart joined B. F. Goodrich in 1939 following graduation from the University of Washington with a bachelor of science degree in chemistry.

✦ L. L. MELICK has been assigned to the field engineering staff in New York of the Bailey Meter Co., Cleveland. Other recent assignments include: Mr. J. F. Triolo to Philadelphia; Mr. G. M. Wallace to San Francisco; Mr. B. F. Elias to Cincinnati, and Mr. D. E. Smith to Buffalo.

✦ W. B. MARSHALL who has been assistant sales manager of the conveying and engineering products division of the Chain Belt Co., Milwaukee, has been made sales manager of that division. Mr. Marshall has been with the company since 1920. Besides being assistant sales manager, he has been in charge of the development and sales of sanitation equipment. He graduated from Sheffield Scientific School of Yale University in 1921.

✦ PAUL T. TALBOTT, ceramic engineer, has joined the research staff of Battelle Memorial Institute, Columbus, Ohio, and has been assigned to the division of ceramic research. Mr. Talbott graduated from the University of Illinois. Previous to joining the Battelle staff

he was associated with the Cerro de Pasco Copper Corp., Peru.

✦ L. M. Forncrook, vice president of the Elliott Co., is acting as operating head of the company. Late in July, the president, Mr. James E. Watson, tendered his resignation.

✦ Richard B. Engdahl has joined the research staff of Battelle Memorial Institute. He has been assigned to the division of fuels research and will assist in an investigation of the use of pulverized fuel for the firing of ceramic and metallurgical furnaces. He is a graduate of Bucknell University and the University of Illinois. He was research assistant and member of the faculty at the latter school previous to joining Battelle.

✦ Andrew W. Liger has joined the research staff of the Battelle Memorial Institute. He has been assigned to the division of electrochemical research. Mr. Liger was formerly associated with the W. B. Jarvis Co., Grand Rapids, Mich. He is a graduate of the Michigan College of Mining and Technology.

✦ C. B. Voldrich has been named a research engineer on the technical staff of the Battelle Memorial Institute where he will assist in the institute's program of welding research. Previous to joining the Battelle staff, he was associated for four years with the Navy's bureau of ships. Earlier he was a research engineer with the A. O. Smith Corp., Milwaukee.

✦ W. F. Rockwell, president of the Pittsburgh Equitable Meter Co. and the Merco Nordstrom Valve Co., Pittsburgh, Pa., has been appointed a national councilor of the Chamber of Commerce of the United States to represent the Association of Gas Appliance and Equipment Manufacturers. Through his close contact with the gas industry, Colonel Rockwell is in a position to give valuable assistance to the Council on its pertinent problems.

✦ L. W. Wallace, research and management engineer, has joined the staff of the Trundle Engineering Co. as vice president. Before accepting his new position, Mr. Wallace was director of engineering and research of the Crane Co., Chicago. After receiving his B. S. degree from Texas A. & M. College and serving an apprenticeship in the shops of the Gulf, Colorado & Santa Fe Railroad, Mr. Wallace joined the faculty of Purdue University where he taught for 11 years. He is a member of the board of directors of the Purdue Research Foundation.

✦ E. E. Litkenhous has resigned from the University of Louisville in order to become head of the chemical engineering department at Vanderbilt University.

✦ Paul D. V. Manning, Pacific Coast editor of *Chem & Met.*, since 1926, and prominent in Western chemical engineering activities, has resigned to become director of research for the International Agricultural Corporation with headquarters in Chicago. In so doing he returns to research and development work in the inorganic chemical industries with which he was associated following his under-graduate training at Stanford University and his graduate work at the California Institute of Technology and Columbia University, which led to his doctor's degree in chemical engineering from the latter institution in 1927. This experience included consulting or full-time employment with the Fixed Nitrogen Research Laboratory, Chile Exploration Co. (with Dr. C. G. Fink) International Coal Products Co. (with Dr. H. A. Curtis), Inyo Chemical Co. and Marine Magnesium Products Corp. as vice president and director.

As a consulting engineer, Dr. Manning participated in the development of the Peebles evaporators and spray dryers and their application to the chemical and food fields, becoming vice president of the Western Condensing Co. in 1936. He is a coinventor with D. D. Peebles in a number of patents. More recently he organized and directed the Research Laboratories of the Golden State Co., Ltd., from which have come a number of important advances in food technology and vitamins. He has been a registered engineer in the state of New York since 1924.

Paul D. V. Manning

✦ Eugene E. Everett, formerly with Muncie Gear Works as process engineer and metallurgist, has joined the A. F. Holden Co. in the same capacity.

✦ Adam L. Wesner has joined the technical staff of Battelle Memorial Institute, Columbus, Ohio. He has been assigned to the division where materials benefications of coal laundering and ore dressing methods are in progress. He was formerly associated with the Bureau of Mines.

OBITUARY

Harold A. Bunger

✦ Harold Alam Bunger, head of the department of chemical engineering and director of the State Engineering Experiment Station at Georgia School of Technology, died suddenly of a heart attack in Minneapolis, August 14. In excellent health almost to the moment of his untimely death at 45, the news came as a great shock to his many friends in the profession.

More than two years of overseas service with the famous Rainbow Division in the A.E.F. delayed his collegiate training, but by June 1925 he had received his Bachelor's degree in chemical engineering from the University of Minnesota. For a year he worked in the Experiment Station of the Hercules Powder Co. at Kenvil, N. J., where an unfortunate explosion very seriously damaged his eyesight. Returning to Minnesota for graduate work, he got his Ph.D. in 1929 and immediately became an instructor in chemical engineering at Georgia Tech. He rose rapidly to head the department in 1935 and his extensive research on naval stores and rayon from Southern pine pulp led in 1940 to the directorship of the Engineering Experiment Station. His latest work, on the point of being commercialized, had to do with the utilization of flax fiber.

Associate Professor Jesse W. Mason carries on with the work of the department of chemical engineering at the Georgia School of Technology.

✦ Thomas Waddell Gangloff, technical manager of the Hazard Insulated Wire Works Division of the Okonite Co., Passaic, N. J., died August 10 at the age of 49, after a brief illness in Wilkes-Barre, Pa. Following a technical education at Cornell and Lehigh Universities, Mr. Gangloff entered the employ of the Hazard Manufacturing Co., on Oct. 30, 1916 and some years later was advanced to the position of chief chemist. In 1928, when the Okonite Co. acquired the plant, he was appointed technical manager of the

Hazard Insulating Wire Division of the Okonite Co., which position he held up until the time of his death.

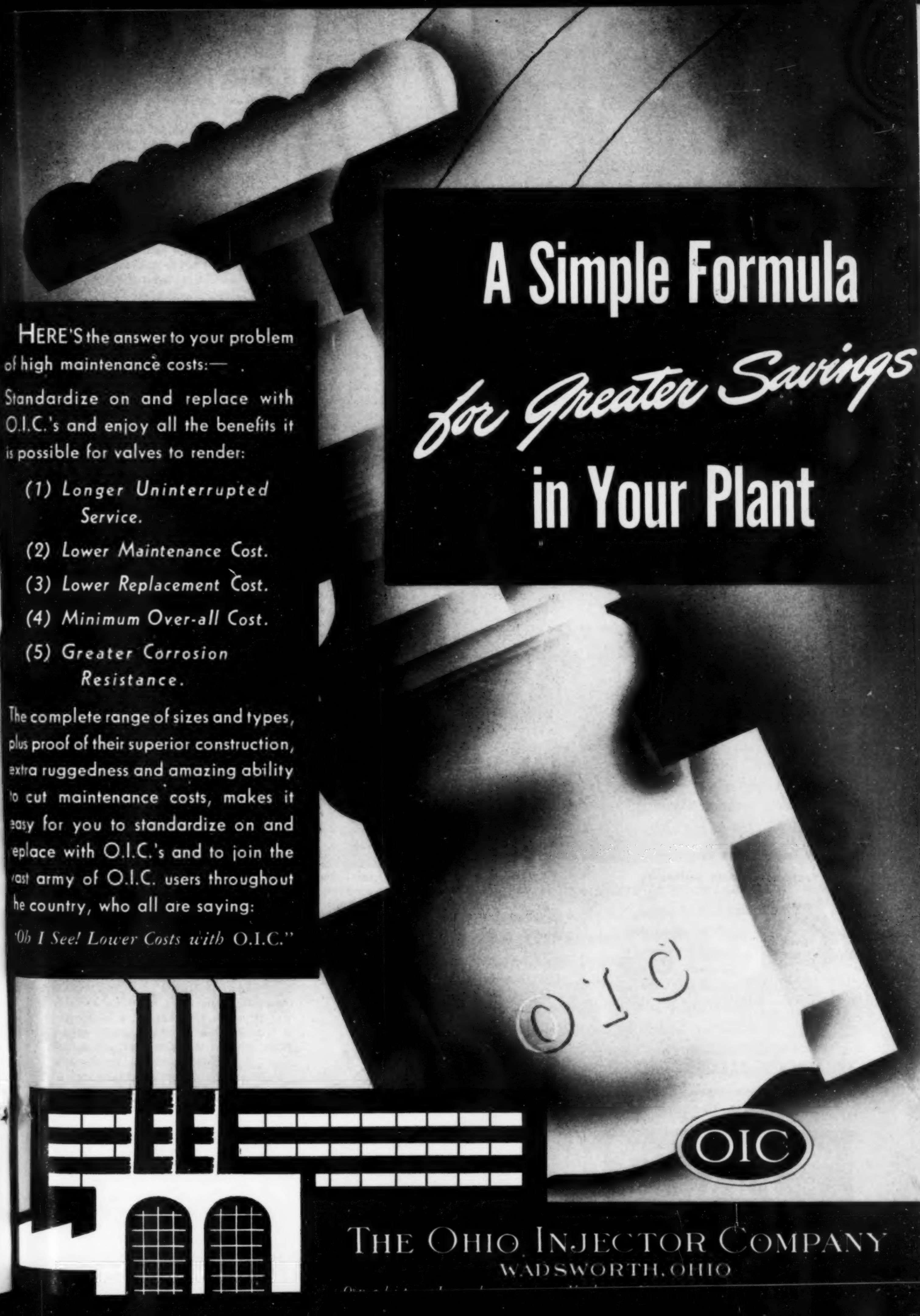
✦ JASPER WHITING died Aug. 18, at his home in Dublin, N. H., at the age of 73. Among his developments were a process for the production of portland cement from waste products and the Whiting cell for the manufacture of chlorine and caustic soda.

✦ FLOYD W. PARSONS died Aug. 7, in Post Graduate Hospital, New York, after an illness of two weeks. He was 61 years old. For the last 21 years he was associated with Robbins Publishing Co.; at his death he was a member of the board of directors, editorial director, and vice-president of the company, editor of *Gas Age* and *Industrial Gas* and contributing editor of *Advertising & Selling*. He was founder and editor from 1910 to 1918 of *Coal Age*. From 1907 to 1910, he was associate editor of *Engineering and Mining Journal*. Mr. Parsons was born in Keyser, W. Va. and attended the University of West Virginia and received an E. M. degree from Lehigh University in 1902.

✦ CLARENCE H. KENNEDY, vice president in charge of sales of Kennedy Valve Mfg. Co., Elmira, N. Y., died July 21 after an illness of several months.

Daniel D. Jackson

✦ DANIEL DANA JACKSON, head of the department of chemical engineering of Columbia University since 1918, died at his summer home at Mattituck, L. I., Sept. 1. He was 71 years old. Born in Gloucester, Mass., Aug. 1, 1870, Professor Jackson was graduated from the Massachusetts Institute of Technology in 1893, with a bachelor of science degree. He attended Harvard Graduate School, from which he received a master of science degree in 1897. In 1911 he started giving lectures at Columbia on sanitary engineering and bacteriology and two years later was named assistant professor of chemical engineering, becoming associate professor in 1917.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NEWS OF PRODUCTS AND MATERIALS

ADDITIVE FOR WAXES

Recent research shows that Triton W-30 is an excellent additive in self-polishing floor waxes, according to an announcement made by Rohm & Haas Co., Philadelphia. The product is said to improve the luster of the waxes and to give them better setting qualities. In addition tests have shown that it prevents creeping of the dried wax film, thereby overcoming a deficiency of many polishes.

TRUCK TIRES

With the combined needs of national defense and increased trucking activities resulting in peak demand for truck tires, the B. F. Goodrich Co. announces a new tire designed to conserve rubber supplies by producing more mileage per pound of rubber. This new tire known as the Speedliner Silvertown, gives 25 percent more mileage than any other regularly priced truck tire the company has ever made. Secret of the new construction lies in a radical change in the position of the breaker strips, the cushioning rubber and cord units that normally float on top of the carcass just underneath the tread to resist road shock and bruising. The new construction for which patents are pending is known as Load-Shield and is further strengthened according to the announcement by a special ply of heat-resisting Tyton rubber that completely surrounds the carcass, including the breakers, to form a perfect bond with the tread.

MACHINERY FINISHES

Machinery finishes must resist many conditions which cause paints and enamels to deteriorate according to the paint technicians of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. Contact with oil, grease and other solvents, temperature variations from cold to intense heat, and abrasion tend to shorten the life of finishes. New synthetic resin-base machinery finishes possess greater durability than oil or varnish-type enamels. They are relatively unaffected by contact with petroleum oils or grease, and highly volatile thinners affect them but slightly. Synthetic resin enamels are found by the bottling and dairy industries to stand up and keep their color in spite of spillage of a variety of liquids. They also withstand daily hosing down and give excellent service under the most sanitary routine.

MILDEW PROOFING

The Bureau of Home Economics, U. S. Department of Agriculture, has announced that a new process for making cotton and other fabrics mildew resistant, has been devised in its laboratories. The immediate application is intended to be on Army equipment such as tents. The research work was done by Helen M. Robinson, who has obtained a Public Service patent 2,247,339. Hence the process may be used by anyone without royalty. It is claimed that the new process has several applications as an effective protection against mildew and rotting. It is comparatively inexpensive and uses non-toxic materials. It is, therefore, anticipated that it may have value for household textiles as well as in commercial use.

LAURIC ACID

Lauric acid of low titre, synthetically made, is known as Lauralene, which is said to be available in large quantities from the Beacon Co., Boston, Mass. It is of particular interest for soap making, plastics specialties, wetting agents, cosmetics, hair shampoos, rubber compounding, and special mold lubricants. The specifications are as follows: acid number—324; saponification number, 366; percentage unsaponifiable 0.2; Lovibond color (6 in. cell), red 6.6, yellow 29.

SYNTHETIC MILL WHITE

Synthetic mill white which is said to cover with one coat and dry overnight to a hard tile-like surface, is announced by the Sherwin-Williams Co., Cleveland. The new finish called Kem Save-Lite is recommended for plants where unusual conditions require maximum durability, faster drying, and extremely sanitary washable surfaces. It combines a new synthetic vehicle with improved pigments and reflects and diffuses as much as 89 percent of the light entering a plant. In addition, it is said to remain white longer than previous mill whites, yet it applies as easily as oil paint.

EXPLOSIVE RIVETS

Explosive rivets, a recent innovation, may prove an important factor in speeding American aircraft production and simplifying design. They are made by E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. Now being manufactured in commercial quantities, the rivet is of an entirely new type. A high explosive is secreted in a cavity at the end of the shank. Heat applied to the rivet head by an electric gun detonates the charge, the explosion expands the charged end of the shank, thus forming a blind head and setting the rivets. The whole operation is performed from one side with greater ease and speed than is possible by any mechanical means now being used in aircraft factories. So finely has the explosive charge been controlled, that the expansion it affects may be held within limits of 20/1000th of an inch.

SOLVENT SOLUBLE RESIN

An improved modification of Uformite F-226 and since its viscosity-solids and compatibility characteristics are very close to those of the older product, F-226-E is expected to replace F-226 because of its advantages in other respects. Uformite F-226-E belongs to the class of solvent-soluble urea-formaldehyde resins which finds wide use in baking finishes, according to a recent announcement of The Resinous Products & Chemical Co., Philadelphia. In common with other Uformite resins of this class, it is characterized by its extreme hardness and mar-proofness, excellent color and resistance to after-yellowing and excellent resistance to organic solvents, greases and vegetable acids. It is a heat-hardening resin and should be used in baking finishes at schedules adequate to cure the resin, and in conjunction with flexible film-forming ingredients, especially alkyd resins. It will tolerate dilution with petroleum thinners and is compatible with a wide range of alkyds and varnishes.

Specifications:

Solids	48-52%
Solvent	Capryl alcohol
Viscosity	W-Z_1 (as supplied)
Color	Water white
Specific gravity	0.98
Pounds per gallon	8.1

AID TO TEXTILE FIBERS

A process for making fibers take moisture rapidly has been developed by the Sorbtex Foundation, Richmond, Va. The process is said to be quite different from any other designed to aid textile fibers, and is made up of a complex carrying agent and an absorbent. It is not one which deals with surface activities such as wetting agents. Sorbtex has unusual properties for rewetting, the ability of the fiber to take moisture or water after treatment and drying. The absorbent which is placed within the fiber has great affinity for moisture and rewets readily. Actual tests show Sorbtex processed fibers dry 20 percent faster than the same untreated fibers. Which means that only 80 percent of the water has wet the fibers and the remaining has been held by the absorbent. This absorbent rejuvenates itself, giving up its moisture as the cellulose fibers become dry.

TEXTILE CHEMICAL

Since supplies of Neocarmine are not coming through from Germany, the Chemical Research Laboratories, New York, N. Y., have developed Celotex B, a universal textile indicator, which was put on the market May 1. Celotex B is manufactured by the General Chemical Mfg. Co. of the same address and is distributed by the Neuberg Chemical Corp., New York, N. Y. Need for this product in the textile trade in both the United States and South America is said to be great. Tests are said to have proved Celotex B superior to the German product.

Chem & Met MEETINGS & CONVENTIONS

T.A.P.P.I. Meets in Ann Arbor

With the coming of the autumn season, meetings and conventions of the technical societies are again in full swing. Leading off, the American Chemical Society held one of the most successful semi-annual meetings in its history at Atlantic City early in September. And T.A.P.P.I., now in session at Ann Arbor, promises the same story. The Electrochemical Society is busy preparing for its convention early in October in Chicago, while of especial interest to every chemical engineer is the A.I.Ch.E. annual meeting scheduled for November 3-5 at Virginia Beach.

EXPLOSIVE RIVETS

An important factor in speeding American aircraft production and simplifying design may result from the use of explosive rivets, stated D. L. Lewis, Jr. of the E. I. du Pont de Nemours & Co. before the American Chemical Society in Atlantic City. Now being manufactured in commercial quantities by duPont, the rivet is of an entirely new type, although originally developed in Germany several years ago.

High explosive is secreted in a cavity at the end of the shank. Heat applied to the rivet head by an electric gun detonates the charge. The explosion expands the charge end of the shank, forming a "blind" head and setting the rivet. The whole operation is performed from one side. Engineers estimate that from 800-10,000 fastening points in a plane are accessible from one side only and a skilled workman can now set only about 2-4 of these blind fasteners per min., while the equipment is comparatively costly. The new rivets can be installed by one workman at the rate of 15-20 per min. The riveting gun weighs less than 5 lb. and the rivets themselves weigh only about one-fourth as much as the generally used blind fasteners. The explosion charge has been so controlled that expansions are held within limits of 0.02 in.

Heat is supplied by a specially designed electric tool with a silver tip. Time of installation is 1.5-2.5 sec. from the time the iron is applied until expansion takes place. The rivets are now being manufactured of an aluminum alloy in various diameters and sizes. They are safe and may be used without fear of serious injury although they should be handled with reasonable care. Tests have indicated that they will not detonate in mass and are quite insensitive to shock and friction, but fire or high heat will cause them to expand. It was stated that several million explosive rivets have already been sold and are being used by American aircraft actually in service.

CLEANING MAGNESIUM DIE CASTINGS

Magnesium die castings may be cleaned by solvent, alkaline or acid methods, according to H. W. Schmidt of the Dow Chemical Co., Midland, Mich., before the American Society for Testing Materials in Philadelphia.

Vapor degreasing methods are satisfactory in cases where large amounts of oil or grease are to be removed, but are not recommended preparatory to certain of the chemical treatments unless the degreasing step is followed by boiling in 2-5 percent caustic soda solution for 5-10 min., or by treatment in other strong alkaline cleaners.

Strong alkaline cleaners are the most satisfactory. The procedure may be by boiling or by cathodic electrolytic methods. A satisfactory degreasing solution either for boiling or for electrolysis was given as follows:

Trisodium phosphate	4 oz.
Sodium carbonate	4 oz.
Soap	0.1 oz.
Water to make 1 gal.	

Soap may be replaced by a suitable wetting agent. This cleaning solution is operated at 90-100 deg. C., and the time required is 5-15 min. As an electrolytic cleaner, the solution may be operated below the boiling point without the necessity of agitation. The magnesium is made the cathode in the solution and a direct current of 10-28 amp. per sq. ft. of surface is applied. Usually one to three minutes are required for complete removal of oil or grease.

Oxide remaining on the surface after alkaline cleaning may be removed by a chromic acid solution as this does not attack the metal. Chromic acid (1.5 lb.) is made up with water to make one gal. of solution. The parts to be cleaned are immersed for one to five minutes in this bath at 90-100 deg. C. Water which has an appreciable chloride content can be used, provided a small amount (usually 0.1 percent) of silver nitrate is added to precipitate excess chloride.

SILVER AS A SUBSTITUTE METAL

The American Silver Producers' Research Project, sponsored by several leading silver producing companies and now being conducted at the Bridgeport plant of Handy & Harman, continues to show promise for silver as a substitute metal. At the present time a large can manufacturer is cooperating with the project and a chemical supply house in the development of a silver-lined can for packaging chemicals.

Where sheet or foil aluminum has been used for corrosion resistance or high reflectivity, silver plating can be substituted since it possesses the same qualities, for most purposes, to a better degree than aluminum. Silver electro-deposits are being investigated as a substitute for nickel, as an undercoating for chrome plating. Experiments are under way to determine possible advantages from using a corrosion-resistant electroplate of silver followed by a hard, wear-resistant chromium deposit.

Experiments have also been conducted to determine the strength of extruded tubing made from a 3.5 percent silver-96.5 percent tin alloy. A bursting strength of 2,500 lb. per sq. in., or almost double that of pure tin, was obtained. This is apparently in excess of any working pressure encountered in distilled water lines where this material is finding commercial use. Tests on threaded joints

CALENDAR

SEPT. 16-19,	Technical Association of the Pulp and Paper Industry, fall meeting, University of Michigan, Ann Arbor, Mich.
OCT. 1-4,	Electrochemical Society, semi-annual meeting, Hotel Knickerbocker, Chicago, Ill.
OCT. 19-24,	American Welding Society, 22nd annual meeting, Bellevue-Stratford Hotel, Philadelphia, Pa.
NOV. 3-5,	American Institute of Chemical Engineers, annual meeting, Cavalier Hotel, Virginia Beach, Va.
DEC. 1-6,	18th Exposition of Chemical Industries, Grand Central Palace, New York, N. Y.

Announcing

AN IMPORTANT NEW BECKMAN DEVELOPMENT

THE BECKMAN Spectrophotometer

Features Many Unique and Far-Reaching Advancements

This precision instrument—the product of several years intensive development by the Beckman research staff—incorporates many important advancements in the design of spectrophotometric equipment, such as:

... *the finest type* of crystal quartz monochromator which covers the full spectral range of interest in spectrophotometry—200 millimicrons in the ultraviolet to 2000 millimicrons in the infrared.

... *precision* optical parts completely protected from dust and fumes.

... *extra long* (100 cm) easily-read Wavelength Scale.

... *direct readings* in both % *Transmission* and *Density*—simultaneously.

... *continuously adjustable* Slit Mechanism to fit every possible requirement.

... *full scale readings* with nominal band widths 2 millimicrons or less over most of spectral range.

... *stray light effects* less than 1/10% over most of the spectral range.

The Beckman Spectrophotometer is entirely *self-contained*, with a unique electronic circuit for rapid measurement of % Transmission and Density. The remarkable versatility of the instrument enables it to meet the widely varying requirements of research and control work with no sacrifice in accuracy or convenience. Regardless of type of Spectrophotometric measurements you are interested in, be sure to investigate the outstanding advantages provided by this new Beckman development!

NATIONAL TECHNICAL LABORATORIES

SOUTH PASADENA, CALIFORNIA

IMPORTANT FEATURES OF THE BECKMAN SPECTROPHOTOMETER

MONOCHROMATOR ★ Auto-collimating type with selected crystal quartz prism provides high dispersion in the ultraviolet. Wavelength scale graduated from 200 millimicrons in ultraviolet to 2000 millimicrons in infrared, easily readable to 0.1 millimicron in ultraviolet to 1.0 millimicron in the red, with scale accuracy better than 1.0 millimicron. Optical parts rigidly mounted in a massive heat-treated iron block, within a dust-proof cast-aluminum case. Slits are protected by quartz windows and are continuously adjustable from .01 to 2.0 mm. by a unique mechanism that permits very precise adjustment, particularly when slit width is small. Slits cannot be damaged by closing too far.

LIGHT SOURCES ★ Interchangeable light sources permit ready adaptability to all types of spectrophotometric work. Efficient design provides full-scale accuracy even with low light intensities. Lamp housing is well ventilated and heat-shielded to minimize temperature changes in absorption cells and phototubes.

SAMPLE HOLDER ★ Absorption cells are held in light-tight slide holding 4 cells with light path of 1 cm. or less. Interchangeable additional holders are available for cells up to 10 cm. in length. Top of cell compartment is removable for titration and other special techniques.

PHOTOTUBES ★ Compartment holds two phototubes, a sliding knob bringing either tube into position and simultaneously switching electrical connections. Phototube dark current can be checked at any time without removing cells (or changing setting of electronic meter). Three types of phototubes are available: one having maximum sensitivity in the red, another having maximum sensitivity in the blue, and a third having maximum sensitivity in the ultraviolet.

MANY OTHER IMPORTANT FEATURES ARE INCORPORATED IN THE BECKMAN SPECTROPHOTOMETER. SEE YOUR NEAREST DEALER OR WRITE FOR DESCRIPTIVE LITERATURE.

showed that the alloy had a tensile strength 25 percent greater than joints made with pure tin tubing. Both the 3.5 percent silver and the 5 percent silver-tin alloys are finding application as solders.

Interest continues in the possibility of using lead-silver solders in place of the standard lead-tin alloys in automatic can-making machines. The 2.5 percent silver-lead alloy is cheaper than the standard 50-50 solder and joints equally as satisfactory can be obtained. Many larger can manufacturers are carrying on experiments with these alloys to obtain data on operating conditions and service tests. The project is continuing corrosion studies on silver, including different chemicals and other products which may be manufactured in silver equipment or packaged in silver containers.

PROPERTIES OF NEOPRENE

IMMUNITY TO THE EFFECTS of extreme cold is becoming of increasing importance in many engineering applications of rubber-like materials, particularly in the operation of automotive and aeronautical equipment. So stated F. L. Yerzley and D. F. Fraser of the E. I. du Pont de Nemours & Co., Inc. before the American Chemical Society in Atlantic City. However, physical changes that take place in such materials at low temperatures are not clearly understood and extensive studies of testing methods and compounding should be continued.

Three test procedures have been employed in the duPont laboratories. From these it has been found that compositions respond differently to the effects of time and temperature. Progress has been made in compounding for greater resistance to low temperatures. The effect of sulphur, softeners and state of cure on the freeze resistance was discussed.

Electrical properties of neoprene have been applied less extensively and as a result are not well known. The author described development of the electrical properties up to the present. The last decade, for example, has seen the d.c. resistivity increased from $5x10^{11}$ ohm cm. to $5x10^{13}$ ohm cm. Neoprene, like rubber, can be rendered electrically conducting and by the same means and to the same extent. The effects of carbon black on conductivity and on other electrical properties were given by the two authors.

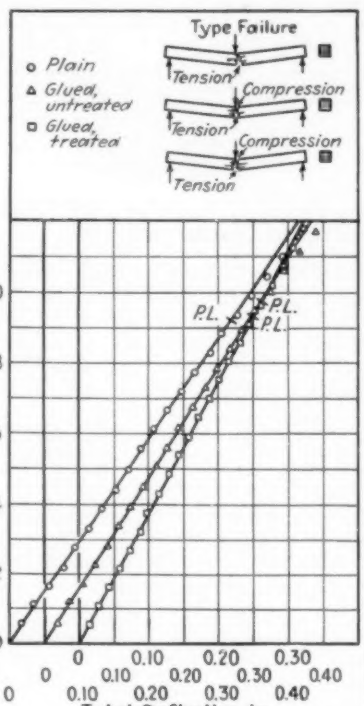
GLUED LAMINATED WOOD

WHILE LAMINATED glued timber structural units are common, these same units impregnated with a preservative material have not been used and very little is known regarding the extent of preservatives upon the properties of the glue. So reported W. A. Oliver of the University of Illinois before the American Society for Testing Materials in Philadelphia last June. The author reported results from a series of tests made to investigate the strength of

glued laminated wood beams treated with creosote.

In order to study the effect of aging of the glue and seasoning of the wood, the tests were carried out at intervals over a period of a year. The author discussed the effect of moisture content and seasoning upon the strengths obtained.

Predominance of tension type of failures indicated that the glued treated laminated beams behaved in a manner similar to both the plain beams and the glued untreated beams. Even where the beams failed in horizontal shear, the strengths obtained did not compare unfavorably with the strengths of the other beams of the same age.



Strength, after 394 days, of glued laminated wood beams treated with creosote

Results in this series show that for practical purposes the glued and treated laminated beams, when properly seasoned, have the same strength as either the plain beams or the glued untreated laminated beams. A full-size glued laminated wood beam may be made of a number of smaller pieces with a greater number of the natural defects eliminated than is possible with a solid beam of the same size. Hence, it would seem logical that results obtained from full-size tests would be even more favorable towards the glued treated beams.

WORLD RESEARCH ACTIVITIES

A DECREASE OF 12 PERCENT in the world's reported chemical research activity for the first half of 1941 as compared with the first six months of 1940 was reported by E. J. Crane, Ohio State University, before the American Chemical Society in Atlantic City.

The United States, producer even in peace-time of more than 25 percent of the world's output of scientific and technical papers of a chemical nature, has as yet shown no noticeable decrease in such publications. Although the effects of the present war between Germany and Russia are not reflected in the figures, the U.S.S.R. up until now has been more than holding its own in scientific output. The British and German periodicals average about half their peace-time size.

Abstracts gathered from more than 3,500 scientific publications in 31 languages and from approximately 65,000 patent references were the basis for the statistics. A decrease of not more than one-fifth in peaceful chemical research activity the world over can be safely predicted for 1941 as compared to 1939. However, research activity conducted for national purposes and not reflected by publication is obviously in high gear in the countries still at war and in those preparing for the possibility of war.

PREVENTING DEZINCIFICATION

TENDENCY OF ZINC-RICH brasses to dezincify under certain exposure conditions is well known, reported W. Lynes, Revere Copper & Brass, Inc., Rome, N. Y., before the American Society for Testing Materials. High zinc brasses are particularly liable to dezincification when in contact with sea water, but they may also eventually fail when exposed to many fresh waters.

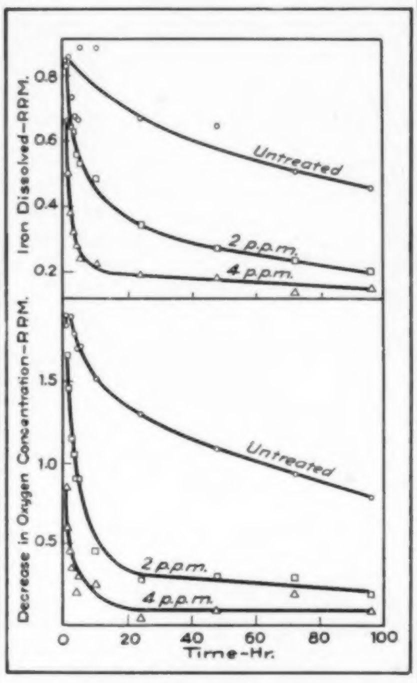
Early attempts to inhibit dezincification of alpha brasses culminated successfully in the introduction of a few hundredths of a percent of arsenic. Later, antimony or phosphorus was used in similar amounts for the same purpose. The author reported laboratory tests on 70-30 and admiralty brasses modified by an appropriate addition of each of the above elements. These tests indicated that dezincification of alpha brass alloys may be suppressed by a small addition of arsenic, antimony or phosphorus without impairment of the alloy in other respects. These conclusions have been confirmed, especially in the case of arsenic, by extensive service experience. Results of the tests are given in the accompanying table.

Nominal Composition	72° F.			150° F.		
	2nd week	6th week	10th week	2nd week	6th week	10th week
Plain 70-30 brass	4.3	19.8	52.3	15.0	49.0	94.6
70-30, 0.03 As	0.0	6.2	9.4	0.4	15.4	38.5
70-30, 0.03 Sb	0.2	4.3	8.2	1.7	24.8	48.5
70-30, 0.03 P	0.0	3.5	5.5	1.6	17.7	41.0
70-30, 0.10 As	0.4	6.8	6.8	3.6	20.2	43.6
70-30, 0.10 Sb	0.4	9.0	12.9	2.1	20.8	42.5
70-30, 0.10 P	0.6	7.8	10.7	1.6	23.0	45.0
Plain admiralty	0.0	8.5	13.4	9.9	49.9	95.2
Admiralty, 0.03 As	0.0	4.2	10.1	0.0	22.7	44.2
Admiralty, 0.03 Sb	0.6	3.4	11.2	2.4	20.2	44.5
Admiralty, 0.03 P.	0.0	6.9	14.4	3.2	26.6	47.8

Average percent losses in tensile strengths of various 70-30 and admiralty brasses immersed in 5 percent cupric chloride-5 percent hydrochloric acid solution for periods from two up to as many as 10 weeks

THRESHOLD TREATMENT OF WATER

Sodium hexametaphosphate for the prevention of scale and corrosion in heat exchanger and water lines was discussed by R. E. Hall, Hall Laboratories, Inc., Pittsburgh, Pa., before the American Gas Association in New York. The author also discussed the use of this glassy metaphosphate for the cleaning of greasy surfaces. He pointed out that wherever grimy and greasy surfaces are to be cleaned, the combination of alkali detergents and scale-preventing hexametaphosphates can be used advantageously. In boiling out new boilers, for instance, the time required is from a quarter to a third as much as formerly and the results are better. The author gave illustrations, detailed data, and advantages of the use of Calgon (sodium hexametaphosphate) as applied to condensers, to city and industrial waters, and in the home.



Influence of Calgon in decreasing corrosion in flowing Pittsburgh tap water at a pH of 6. Oxygen and dissolved iron are lowered markedly by use of this phosphate

Incidental to development of the use of the "threshold" treatment, it was noted that its maintenance was effective in suppressing corrosion. The formation of a protective film and its stability, and therefore the protection afforded against corrosion, were satisfactory in the pH range of 5.2-10. The accompanying chart shows that when Pittsburgh tap water, not treated by Calgon, was passed through steel wool, some iron dissolved and the amount found in the effluent was slightly more than 0.8 p.p.m. The amount dissolved increased slightly, but after 100 hours was approximately 0.5 p.p.m. When Calgon-treated water was used, initial dissolving was about the same as with the untreated water, but this rapidly

decreased so that at the end of 100 hours the amount in the effluent was about 0.2 p.p.m.

MAGNESIUM DIE CASTINGS

CHEMICAL TREATMENTS ARE USED on magnesium die castings to provide: (1) increased corrosion resistance, (2) a base for organic coatings, and (3) a decorative effect, according to H. W. Schmidt, Dow Chemical Co., Midland, Mich., before the American Society for Testing Materials at its meeting in Philadelphia last June.

A chrome-pickle treatment is normally given all magnesium die castings to protect the metal during shipment, storage and machining. The treatment will remove 0.006-0.002 in. of metal from the surface and is not recommended on machined surfaces where close dimensions must be held. The following solutions may be used:

(a) Sodium dichromate ($2H_2O$) . . . . 1.5 lb.
Conc. nitric acid (sp. gr. 1.42) . 1.5 pt.
Water to make one gallon.
(b) Chromium trioxide . . . . 1.0 lb.
Conc. nitric acid (sp. gr. 1.42) . 0.9 pt.
Water to make one gallon.

Temperature of the solution should be 125-135 deg. F. and time of treatment 10 sec. After removal from the treating solution, die castings should be exposed to the air for about 5 sec. before rinsing thoroughly in cold water and then in hot water to facilitate drying.

Sealed Chrome-Pickle—A modification of the chrome-pickle which will give increased corrosion resistance, consists in boiling in a bichromate solution. The die casting, which has been previously chrome-pickled, is immersed for 30 min. in a bath containing 1-2 lb. of sodium, potassium or ammonium bichromate per gal. The bath is maintained at boiling temperature and the solution is controlled to a pH of 4.0-4.4.

Hydrofluoric Acid-Dichromate—This treatment gives practically no change in dimensions. Parts are immersed for 5 min. in a solution containing 15-20 percent by weight of HF, and then are rinsed thoroughly in cold water, boiled for 45 min. in a solution containing 1-1.5 lb. of sodium dichromate per gal. and then rinsed thoroughly in cold water followed by a dip in hot water. The concentration of HF should not be allowed to fall below 10 percent.

Hydrofluoric Alkaline-Dichromate—Parts are immersed for five min. in a 15-20 percent HF solution, washed thoroughly in cold running water, and boiled for 45 min. in the following solution:

Ammonium sulphate . . . . 4 oz.
Sodium dichromate ($2H_2O$) . . . . 4 oz.
Ammonia (sp. gr. 0.880) . . . . . . ½ fluid oz.
Water to make one gallon.

Depletion of the bath is indicated by non-uniform or pale coatings, slowness of coating formation, and by an increase in the pH to about 6.2. To revivify the bath, add a solution containing equal parts by weight of

chromic acid and concentrated H_2SO_4 (sp. gr. 1.84) until the pH is decreased to 5.6. The best operating range of the bath is a pH of 5.6-6.0. Wash thoroughly in cold water and boil for at least 5 min. in a solution containing one oz. of arsenious acid per gal. Because of the low cost of this bath no control is advocated.

Chrome-Alum Treatment—Parts are immersed in a boiling solution of the following composition:

Potassium chrome alum (24 H_2O) . . . . 4 oz.
Sodium bichromate ($2H_2O$) . . . . 13.3 oz.
Water to make one gallon.

Time of treatment may range from 2-15 min. Upon removal from the bath, the parts should be rinsed thoroughly in cold water followed by a hot water rinse to facilitate drying. The solution may be revivified by the addition of H_2SO_4 not exceeding 0.33 fluid oz. per gal. or sufficient to just redissolve a brown precipitate which settles out. The solution should then be boiled. It is best controlled by additions of H_2SO_4 to maintain the pH between 2.5-3.5. The pH of a depleted solution is 5.5.

AGRICULTURAL CHEMICAL RESEARCH

CERTAIN MAJOR ACCOMPLISHMENTS of the U. S. Bureau of Agricultural Chemistry and Engineering were recently outlined by Dr. Henry G. Knight upon receipt of the medal of the American Institute of Chemists in New York.

One outstanding development was that of extracting starch from sweet potatoes, as a result of which a plant, the only one of its kind in this country, was built at Laurel, Miss. This plant manufactured 140,000 lb. of high-grade white starch in 1934, and increased production each year until it ground around 275,000 bu. of potatoes and turned out nearly 3,000,000 lb. of starch in 1939. The cost of manufacturing this starch was reduced from 13 cents a lb. in 1934 to about 3 cents a lb. last year. The Laurel plant, controlled by about 1,000 cooperative sweet potato farmers, made a profit for the first time in 1939. A recent test has shown that dextrin made from sweet potato starch could be used for the adhesive on postage stamps. The starch may also be used for sizing in textile mills, in laundries, and other industries, as well as for food purposes.

Considerable research has been made in the development of paints, varnishes, and enamels from soybean oil and in making plastics from the meal after the oil has been extracted. Partly as a result of research by government scientists, great quantities of paint-containing soybean oil are now sold, and one paint company alone reports that it has made and sold more than 1,000,000 gal. of soybean oil paint. Soybean paint may now be used for painting houses, barns and other objects and it is being tried experimentally for marking streets and highways in spite of the fact that this requires a very quick-drying paint.

In an effort to develop a substitute for lead arsenate insecticide, government scientists became interested in phenothiazine, a product made by reacting sulphur and diphenylamine. Subsequent developments have proved that phenothiazine is extremely valuable as a urinary antiseptic, something which has been needed for a long time. In addition, it is valuable as an anthelmintic for intestinal infections of sheep, hogs and other domestic animals. Phenothiazine is now used extensively for this purpose and it has already saved thousands of dollars to the livestock industry of this country.

Dr. Knight also discussed the four Regional Research Laboratories of the Department of Agriculture. All of the laboratories, for which an annual appropriation of \$4,000,000 was authorized in 1938, have been occupied and research is now under way. There is an average of more than 40 scientists employed at each of the laboratories, or a total of more than 175 at the four. In addition, there are about 25 sub-professional employees plus the clerical and administrative help. Altogether there are more than 400 persons already at work in these laboratories and expansion will continue until there will be a total of 800-1,000 scientists searching for industrial outlets for farm crops.

CATHODIC PROTECTION FROM CORROSION

CATHODE METHODS to combat corrosion of metallic structures in contact with water have been applied for years to submerged and underground cables and pipelines, and in a few instances to shell-and-tube type condensers or coolers, reported N. A. Miller, Universal Oil Products Co., Chicago, Ill., before the American Petroleum Institute in Tulsa. Some installations have used zinc plates as anodes, depending upon galvanic action between the anodes and the structure to be protected, which structure acts as a cathode. The remainder have used external forces of potentials to produce the protective current.

Cathodic protection of pipe lines has produced beneficial results, and a good deal of valuable data have been recorded. So far, however, there has been little or no published information of a strictly technical nature on cathodic protection of open-tank condensers in spite of several successful installations.

Cost of anodes and wiring for one installation was estimated to be approximately \$650. The cost of a copper-oxide weatherproof rectifier rated at 10.5 volts, 78 amp., would be approximately \$350. The total cost of the unit, therefore, was approximately \$1,000 which, when amortized in five years, gave an annual cost of \$200. Added to this was the cost of energy which, at 1 cent per kw.hr., did not exceed \$60 per year. The total annual cost, therefore, was \$260. Annual cost of replacing coils was approximately \$1,000 per year. Hence, even if the

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cathodic-protection equipment is only moderately effective, it will pay out within a short time.

FLUE-GAS RECIRCULATION

FLUE-GAS recirculation and air-preheater systems in fired tubular heaters were used fairly extensively in the petroleum industry a few years ago. At the present time, however, there appears to be a general trend away from the use of these types of equipment. Performance tests run on a number of plant installations made from 10–15 years ago have been restudied on the basis of present-day costs and refinery practice, reported C. C. Nelson, Standard Oil Development Co., Elizabeth, N. J., before the American Petroleum Institute in Tulsa, Okla. The author reported several test runs which he carried out with a cracking furnace equipped with both a flue-gas recirculation system and an air preheater.

Flue-gas recirculation, the author concluded, appears to be economical only with existing heaters which are subject to radiant-section overheating. With new designs there is insufficient advantage to justify the installation of such a system, unless unusually high temperatures are anticipated.

Air preheaters, effective in improving furnace efficiencies, are of doubtful utility in ordinary refinery heaters, as maintenance and repair costs may outweigh heat savings. At present fuel oil prices, particularly in Southern refineries, the use of air preheaters is even less attractive than formerly.

Flue-Gas Recirculation Test

	With Flue-Gas Recirculation	Flue-Gas Recirc. and Air Preheat.
Gas at fur. exit, lb. per hr	24,100	26,800
Recirc. gas, lb. per hr	10,000	12,000
Excess air at fur. exit	20%	12%
Gas temp. leaving fur., °F	794	918
Gas temp. in stack, °F	749	281
Oil per 10 mil. Btu, gal	99.5[1]	86[1]
Fuel saving, gal. per hr	13.5	27
Installation cost	$9,000	$20,000
Fuel saving, per year:		
At $1.68 per bbl., 1926	$3,900	$7,800
At $1.20 per bbl., 1941	2,800	5,600
At $0.80 per bbl., 1941	1,850	3,700
Annual returns,[2] percent:		
N. Y., 1926	43	39
N. Y., 1941	31	28
Southern U. S., 1941	20.5	18.5

[1] Data on and below this line are actually averages for two tests.
[2] Excluding depreciation, maintenance and power.

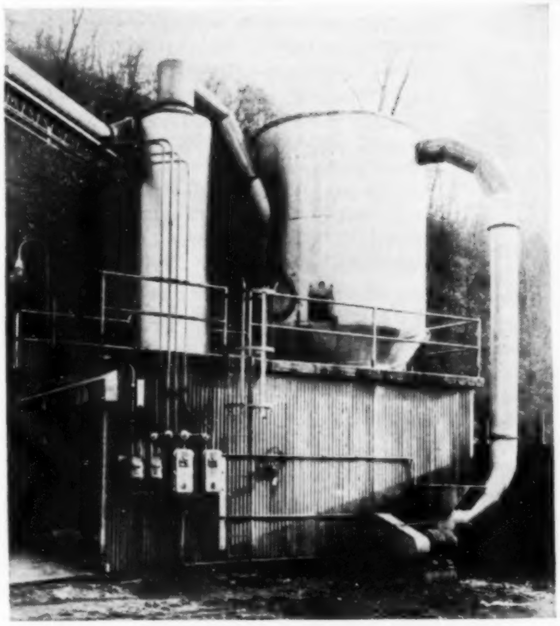
Air-Preheater Tests Cracking-Coil Furnaces[1]

	Without Preheater	With Preheater
Lbs. flue gas per hr	20,400–34,400	16,300–41,000
Stack temp., °F	640–1,040	305–495
Excess air, %	33–70	23–130
Fuel fired, gal. per hr	105–153	92–137
Fuel saved, gal. per hr	....	13–18
Power used by fan, kw	....	7–29
Power cost per yr:		
At 1.0¢ per kwh., 1926	$430–2,100	
At 0.4¢ per kwh., 1941	175–833	
Orig. cost of preheater	10,750–12,000	
Est. present cost	15,000–16,300	
Value of fuel saved per yr:		
At $1.68 per bbl., 1926	3,750–5,200	
At $1.20 per bbl., 1941	2,700–3,700	
At $0.80 per bbl., 1941	1,780–2,500	
Annual return,[2] percent:		
Orig. install., 1926	23–40	
Mod. install., N. Y.	15.1–23.5	
Mod. install., South	8.4–15.5	

[1] Tabulated as the range of 3 series averaged from 11 tests.
[2] Excluding depreciation and maintenance.

THE *Third Big Advantage* OF

LUKENS CLAD STEELS



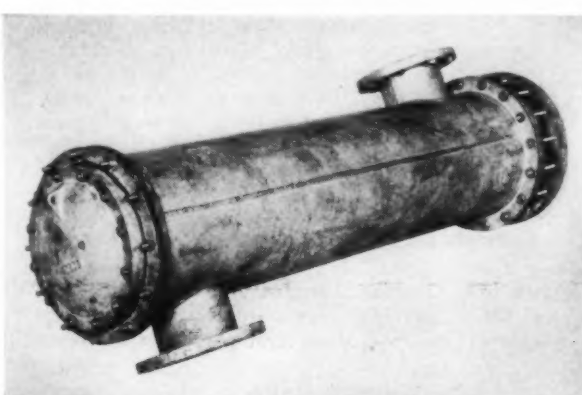
EXPLOSION-PROOF DUST COLLECTOR: Because of the low sparking tendency of nickel, Lukens Nickel-Clad Steel was selected for this explosion-proof dust collector. The Nickel-Clad cylinder is 10′ 3″ in diameter by 12′ 2″ high.

For years Lukens Clad Steels — Nickel-Clad, Inconel-Clad and Monel-Clad have been bringing two big advantages to industry: corrosion-resisting equipment — a saving of thousands of dollars in equipment cost.

Today, Lukens Clad Steels offer a third important advantage: conservation of the available supply of nickel, Inconel and Monel. Every pound of nickel, Inconel or Monel goes ten times as far — makes possible ten times as much corrosion-resisting equipment — fabricated of 10% Lukens Nickel-Clad, Inconel-Clad or Monel-Clad Steel plate.

For data on Lukens Clad Steels and their many applications, write Lukens Steel Co., 143 Lukens Bldg., Coatesville, Pa.

SIZE TANK: Chemicals and resins composing a number of types of paper-making sizes and emulsions cause staining and discoloration of the product in contact with ordinary metals. Nickel-Clad Steel eliminated the trouble in this tank, 2′ 6″ inside diameter and 4′ 0″ over-all height. Fabricated of $\frac{3}{16}$″ and $\frac{1}{4}$″ thick 20% Lukens Nickel-Clad Steel by The Youngstown Welding & Engineering Co., Youngstown, O.



HEAT EXCHANGER SHELLS: For use in condensing toluol containing some hydrochloric acid, the shells of two heat exchangers, 16″ diameter and 6′ 0″ long, were fabricated of $\frac{3}{16}$″ thick 20% Lukens Nickel-Clad Steel by Struthers-Wells, Warren and Titusville, Pa.

VERTICAL TOWERS: In the fabrication of these two vertical towers for processing chemicals, $\frac{3}{8}$″ thick 20% Lukens Nickel-Clad Steel was used. The towers are 3′ 0″ O.D. and 20′ 4″ long on the shell. Nozzles, manhole openings and other fittings were lined with nickel. Fabricated by The Warren City Tank & Boiler Co., Warren, O.

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SELECTIONS FROM FOREIGN LITERATURE

DIESEL FUEL ACCELERATORS

ACCEPTING a cetane number of 50 as the required standard for Diesel engine fuels, and ethyl nitrate as one of the best accelerators, high grade fuel can be obtained from low grade distillates. Thus, only 2 percent of ethyl nitrate was required to raise the cetane number of lignite tar oil from 39 to 58. Aside from the alkyl nitrates and nitrites there are a number of active accelerators for improving Diesel fuels, among them being Tetralin peroxide, ethylenechlorohydrin nitrate, nitrosomethylurethane and diethyl tetrasulphide. On the other hand, some compounds which might be expected to be effective are not, e. g. *p*-nitrosomethylaniline, trinitrotoluene, chlorodinitrobenzene and cyclohexanone oxime. There has been some question as to whether accelerators would lose their potency in stored Diesel fuel. Storage tests (six months) with the accelerators in more or less common use showed no significant loss in potency. Two other problems, however, are not so easily dismissed. One is increased carbon deposition from accelerated fuels and the other is corrosion. Every Diesel fuel accelerator should be tested with as much care on these points as on cetane number.

Digest from "Utility of Diesel Fuel Accelerators," by Heinze, Marder and Veidt, *Chemische Fabrik* 14, 123, 1941. (Published in Germany.)

VELOCITY OF FREEZING

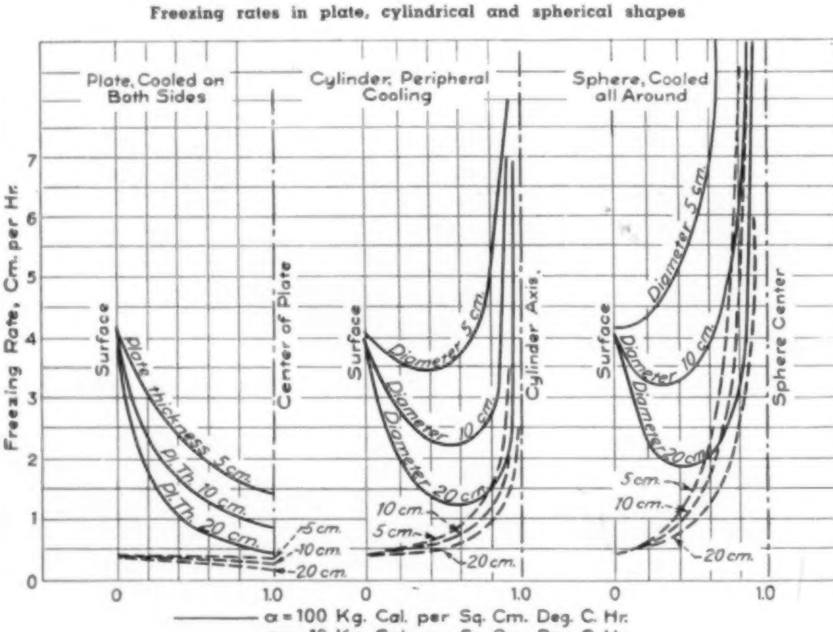
BECAUSE rate of freezing influences both cost and quality in the manufacture of frozen food products the rates of heat transfer from surface to center have been compared for flat plates cooled on both sides, cylinders cooled around the periphery and spheres cooled all around. In plates the rate of freezing steadily decreases toward the center, but cylinders and spheres show a sharp upturn in freezing rate. Fast and slow cooling rates were tested, namely 100 kg.-cal. per sq. cm. per deg. C. per hr. (solid line curves) and 10 kg.-cal. per sq. cm. per deg. C. per hr. (dotted line curves). The chart clearly illustrates the marked difference between plates and cylindrical or spherical shapes.

Direst from "Calculating and Evaluating Freezing Rate," by R. Plank, *Chemische Fabrik* 14, 23, 1941. (Published in Germany.)

X-RAY ANALYSIS IN INDUSTRY

WITH the object of pooling accumulated technical knowledge of the industrial applications in which x-ray analysis is helpful, and particularly in an effort to utilize x-ray methods to utmost advantage in England's war effort, the Institute of Physics has published a series of papers describing experience in several fields. Applications of *x-ray diffraction methods* (C. W. Bunn) include identification of substances present in bleaching powder, locating the cause of color variations in oxide pigments, qualitative analysis of boiler scale, crystallographic study of calcium aluminate and study of molecular structure in plastics. Determination of *phase boundaries in metallurgical equilibrium diagrams* (W. Hume-Rothery and G. V. Raynor) by x-ray methods is useful at relatively low temperatures and in alloys involving superlattice transformations. *Steel works problems* (A. H. Jay) solved by x-ray analysis include examination of silica, magnesia, fireclay refractories, chrome and silicon steels and oxide inclusions in

Freezing rates in plate, cylindrical and spherical shapes



steels. *The x-ray powder method* (H. P. Rooksby) has been applied to testing refractories for glass melting tanks, cathode coatings in radio receiving valves, inorganic fluorophors for fluorescent lighting, nickel-iron powders for loading and radio cores, and lattice distortion in tungsten. *Study of carbon by the Debye-Scherrer method* (A. Taylor) yields useful information concerning the modifications of carbon in coal, coke and graphites. *The x-ray examination of mechanical wear products* (H. J. Goldschmidt and G. T. Harris) helps investigators in the study of abrasive wear on metals. *Spoiling of tungsten magnet steels* (C. Wainwright) is a vexing problem in temperature control; study of specific temperature effects by x-ray examination shows the limits within which good alloys are obtained. *Industrial testing by x-ray diffraction* (J. A. Darbyshire) has solved troublesome problems in corrosion, ceramic insulation failures, carbon deposits on glass and defective nickel cathode filaments in radio valves. It has also yielded important information concerning the reactions in storage batteries. *Identification of clay minerals* (G. Nagelschmidt) is facilitated by studying the x-ray diffraction patterns of thin layers from evaporated clay suspensions. *Changes in physical condition of tungsten* (F. Brech) brought x-ray testing a problem in self study when cooling stresses fractured the target of a medical x-ray tube.

Digest from the first of two special issues devoted to "X-Ray Analysis in Industry" by the Institute of Physics. *Journal of Scientific Instruments* **18**, 69, 1941. Part II will be devoted to technique and some recent advances in the field. Copies of these special issues may be had through book agents or from the Institute of Physics, The University, Reading, Berkshire, England at 2s 8d each.

FURNACE ATMOSPHERES IN GLASSMAKING

UNFAVORABLE furnace atmosphere sometimes causes defects or impairs quality of glass, especially in batches containing sulphate. Oxidizing and reducing atmospheres have different effects on bubbles and other defects and on the progress of decolorization. Changes in the composition of furnace gases, no greater than occur in ordinary practice, may have a greater effect on the glass melt than temperature fluctuations of 100 deg. or even more. Problems of gas consumption, thermal efficiency, condition of burners and life of regenerator chambers are also greatly influenced by furnace atmospheres, especially with respect to oxidizing or reducing properties. Control of furnace atmospheres must therefore be adapted to the kind of batch and the conditions under which it is melted and worked.

By taking advantage of the influence of undergrate blast on output of gas from the producer it is possible to provide automatic control of the

furnace atmosphere when the fuel is unpurified producer gas. This is done by utilizing furnace impulses to control the undergrate blast instead of attempting to control the gas feed directly. The result is that the furnace controls its own gas supply.

Digest from "Glass Batches and Furnace Atmospheres," by H. Jebsen-Marwedel, and "Automatic Control of Furnace Atmosphere When Using Unpurified Producer Gas," by V. Klein, *Chemische Fabrik* **14**, 163, 1941. (Published in Germany.)

STATISTICAL ANALYSIS OF PLANT PROBLEMS

STATISTICAL analysis, introduced in the steel industry about 20 years ago, is now used with much success in solving problems of control, testing, standardization and specification writing. In plotting frequency curves due allowance is made for applying an arithmetic method to variables which follow a geometric course. Any collection of numerical data on a given variable can be plotted as Gauss curves or as a composite of partial Gauss curves. For example, 842 milk samples showed the following distribution of solids content:

Solids	Frequency	Percent	Summation
8.0	2	0.24	0.24
9.0	5	0.59	0.83
10.0	12	1.43	2.26
11.0	13	1.54	3.80
12.0	186	22.08	25.88
13.0	461	54.76	80.64
14.0	140	16.63	97.27
15.0	16	1.90	99.17
16.0	7	0.83	100.00

The frequency curve for these figures is of the single peak type. It is useful for calculating yields of milk powder in terms of freight rates or other cost factors. Other examples include strength distribution of Siemens-Martin steels; causes of failure in steel shovels; rust resistance of steels; rate of rusting in different atmospheres, and similar problems.

Digest from "Evaluating Plant and Experimental Data by Statistical Analysis," by Karl Daeves and August Beckel, *Chemische Fabrik* **14**, 131, 1941. (Published in Germany.)

PULP DIGESTERS

A CERTAIN amount of initial tension is necessary between the iron jacket and the masonry of a pulp digester. The medium through which this tension is exerted is the mortar in the masonry. Safe, reliable operation of digesters demands a more elastic lining than can be obtained with ceramic blocks and bituminous stone has been adopted in some designs to meet this demand. The higher thermal conductivity of bituminous stone increases the heat loss about 16 to 20 percent. If necessary this loss can be prevented by a combination lining of ceramic blocks and bituminous stone against a concrete base. The initial stress between jacket and lining may be too large or too small by reason of inner heating or cooling stresses, excess pressure or local deformation. The mortar must be acidproof, liquid-tight and capable

of swelling. Mechanical stresses can be estimated from pressure-temperature curves. Acid attack on the iron jacket cannot be satisfactorily detected by x-ray examination, but is readily detected by gamma rays from a mesothorium preparation outside the digester, following a counter tube moving inside the digester.

Digest from "Observations on Sulphite Pulp Digesters and Similar Large Vessels," by Rudolf Haas. *Zellstoff und Papier* **21**, 4, 1941. (Published in Germany.)

RECOVERING NITROGEN OXIDES

USE of silica gel as an adsorbent for recovering nitrogen oxides from air at high dilutions is old art, but improvements are still needed. Recent experiments show a sharply defined optimum moisture content of the gel, at which adsorption is most efficient. It also appears that the multiple functions of the gel in this process may be identified as successive adsorption of nitrogen oxide (NO) and then of oxygen (O_2); oxidation catalysis with formation of the tetroxide (N_2O_4) and nitrous anhydride (N_2O_3); and finally, catalysis of hydration of these two oxides with water present in or adsorbed by the gel. By providing optimum conditions silica gel can be used to excellent advantage in the arc process of nitrogen fixation for rapid and complete recovery of nitrogen oxides, even at very low concentrations.

As compared with 82.5 percent recovery and 50 percent oxidation to the higher oxides in a glass bead tower, the silica gel method has been carried (on an experimental scale) to 99.6 percent recovery and 97 percent oxidation to N_2O_3 or N_2O_4. The final temperature of thermal desorption is about 375 deg. C. The optimum moisture content of the gel is about 5 percent, as illustrated by the table.

Moisture content percent	Weight of gas adsorbed g. per g. of gel	Percent
10	0.08	7.98
5.2	0.15	14.9
1.6	0.067	6.66

Digest from "Studies in Recovering Nitrogen Oxides by Adsorption. III. Recovery With Silica Gel," by E. Briner and B. Sguaitamatti. *Helvetica Chimica Acta* **24**, 421, 1941. (Published in Switzerland.)

MIXED CATALYSTS

IN HYDROGENATING benzene Ni is a more active promoter of $Cu:Cr_2O_3$ (95:5) than of straight Cu catalysts. Moreover, the $Cu:Cr_2O_3$ catalyst is less sensitive. Whereas Ni-promoted Cu (0.2 percent Ni) loses 90 percent of its activity by admixture with 0.1 percent Pb the $Cu:Cr_2O_3$ catalyst loses only 63 percent and because of its higher initial activity it is much more active when Pb-poisoned than is the Cu catalyst. Hydrogenation of benzene over Cu is so sensitive to promoters and poisons that the effects of Ni, Bi and Cd in spectroscopic traces are perceptible. Indeed, in the case of Pb as a catalyst poison

the sensitivity is greater than that of the spectroscope. Hence the fact that a sample of Cu is spectroscopically pure is no guarantee that it is not Pb-poisoned.

The effects of Bi, Cd and Pb as catalyst poisons are shown in the table, which represents catalytic hydrogenation of 50 cc. benzene for 12 hours at 350 deg. C. over 5 g. of catalyst at 100 atm. of H_2 pressure in a 350 cc. glass-lined Ipatiev bomb.

Poison wt.—percent	Weight—percent of Benzene Hydrogenated: Bi	Cd	Pb
0.0	33	33	33
0.005	21	6	5
0.05	6	1	1
0.5	2	0	0
1.0	0	0	0

Digest from "Mixed Catalysts," by V. N. Ipatieff, *Chimie et Industrie* **45**, 103, 1941. (Published in France.)

PURIFYING WATER BY ADSORPTION

An extraordinarily versatile and adaptable method of clarifying and purifying water comprises filtration through activated carbon. A single bed filter suffices for ordinary purification, giving water with sparkling clarity. With a double bed filter practically all operations in water purification can be effected, with the exception of softening. As water flows downward from above through a double bed filter containing active carbon the first effect is clarification by removal of suspended matter. Iron and acidic ions are removed next. The first bed contains no active carbon but is composed of layers of sand and zeolites or other agents, chosen to give specific effects such as removing iron. A special agent for removing manganese may be included.

When the bed containing active carbon is reached residual traces of iron, if any, are removed along with impurities which impart undesirable odor or taste. Colored waters are largely decolorized at the same time, and excess chlorine from chlorinated waters is removed. Active carbon filters are specially useful for taking on the extra load in sudden seasonal contamination of ordinarily acceptable water supplies, and for all operations in which general purification and clarification (aside from softening) are required.

Digest from "Use of Active Carbon in Purifying Water," by Fr., *Wochenblatt für Papierfabrikation* **72**, 327, 1941. (Published in Germany.)

FILLER LOSSES IN CIGARET PAPER MAKING

While filler losses in the manufacture of cigaret paper are subject to so many variables that no numerical standards can be stated, it is possible to set up dèfinite limits for any individual case. In general, losses increase as intensity of pulp grinding increases. In descending order of filler retention capacity, paper-making fibers may be rated thus: hemp, linen, jute, cotton, straw, sul-

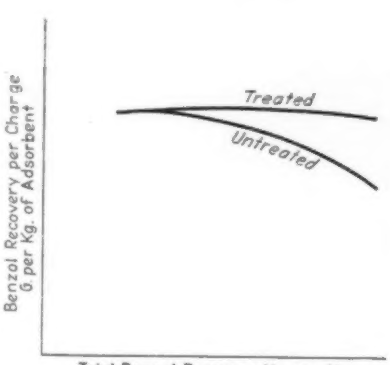
phite pulp and wood pulp. Cigaret paper can be successfully made with as much as 50 percent wood pulp, but only with cheap and strictly neutral fillers, since even slight alkalinity attacks the wood pulp. It is preferable, however, to confine the wood pulp ingredient to a small proportion serving to improve combustibility by increasing porosity. Losses are always higher with magnesia than with lime fillers. Loss is best prevented by precipitating the filler on the fiber. Losses are higher with powdered than with paste fillers. It is essential to know the maximum filler capacity of the pulp used in cigaret papers, in order to evaluate the losses.

Digest from "Filler Losses in Making Cigaret Paper," by E. W. L. Skark, *Wochenblatt für Papierfabrikation* 72, 297, 1941. (Published in Germany.)

DETOXIFYING INDUSTRIAL GASES

CARBON MONOXIDE is so poisonous that fuel gas for general or domestic use cannot safely contain more than 1 percent. To a lesser extent automobile exhaust gas presents a similar problem. Of many methods which have been tried for freeing city gas from carbon monoxide the best is probably the catalytic reaction with steam to form hydrogen and carbon dioxide. For automobile exhaust gas catalytic combustion to carbon dioxide seems to hold the most promise.

Catalytic detoxification frees city gas from other impurities as well as carbon monoxide. Some are removed directly, others are converted to harmless or easily removable reaction products. Thus, hydrogen cyanide yields ammonia, which dissolves in the cooling water. Carbon disulphide yields hydrogen sulphide, which is easy to remove. An unexpected but beneficial effect of catalytic detoxification is that benzol recovery by the adsorption method is more efficient in detoxified gas than in un-



treated gas. This is illustrated by the curve chart, showing nearly constant benzol adsorption capacity from detoxified gas and a rapid decrease in untreated gas.

Digest from "Carbon Monoxide Removal From Gases as Applied to Detoxifying Gases," by Fritz Schuster, *Chemische Fabrik* 14, 31, 1941. (Published in Germany.)

Chem & Met BOOKSHELF

New Titles, Editions and Authors

REVISED TO INCLUDE DUCTS

TRANE AIR CONDITIONING MANUAL. Published by The Trane Co., La Crosse, Wis. 4th Printing, revised. 376 pages. Price, $5.

Reviewed by *T. R. Olive.*

WHEN we reviewed the first edition of this book in June 1938, we expressed the opinion that William Goodman and his collaborators of the Trane staff had done an outstandingly good job in its preparation, in the choice of material and in the development of a new graphical method for making air conditioning calculations. It was our opinion that the book was an essential to any engineer requiring an expert working knowledge of this industry. Despite the several excellent texts that have since appeared, this opinion still holds. The book is still outstanding.

In our earlier review we expressed disappointment that information on air movement and duct design had not been included. This omission has now been corrected, as satisfactorily as the treatment of the original chapters. A new chapter on ducts and fans has been added, making the study of fan characteristics and choice, and duct design, more readily grasped than elsewhere in the literature. Bound as part of the new edition, this material is also available as a pamphlet at a price of $1, or $0.50 to owners of the earlier edition.

Only one adverse comment seems necessary. Where the first edition was liberally illustrated with two-color charts for demonstrating psychrometric and air conditioning problems, the latest printing has employed black alone, with considerable loss in clarity. It is to be hoped that the former style of presentation will be resumed in later printings.

PRINCIPLES OF SEWAGE TREATMENT. By *Willem Rudolfs.* Bulletin 212 published by the National Lime Association, Washington, D. C. 128 pages. Limited free distribution.

IN SPITE of its small size, paper cover, and unassuming announcement that it is "not written to serve as a complete textbook, handbook or manual," this booklet is an excellent discussion and a worthwhile addition to the literature of an important subject. Sources, composition, and microbiology of treatment are briefly reviewed. Chapters on stabilization, methods of treatment, sludge treatment and disposal, chlorination, and plant operation are the subjects forming the main part of the book. A chapter on methods of sewage analysis is included. A glossary of terms concludes the work. There is no index, but the table of contents is very complete and will serve as such. Both Dr. Rudolfs and the Association have done a commendable job.

A REVIEW OF DRIERS AND DRYING. By *E. F. Bennett.* Published by Chemical Publishing Co., Brooklyn, New York. 90 pages. Price $1.75.

TO ACCELERATE the drying of the common paint oils, metallic driers are added in small quantity in nearly all paints and varnishes. This book is an attempt to collect and organize the published work on the subject of driers and drying, bringing the information up through 1940. In the course of the book 106 references are given to the widely scattered technical literature on this subject.

The drying process is usually considered to be a combination of oxidation and polymerization reactions. Among the common driers used, cobalt is considered a good oxidation catalyst, while lead and iron are accelerators of polymerization. Soluble tin and titanium compounds are also used to accelerate polymerization. The pigments used with drying oils may also influence the drying. The author includes a brief classification of the pigments according to their influence on drying, separating those which accelerate and those which retard drying.

The author also includes some discussion of the film structure, as well as mechanism of the chemical reactions involved in drying. Varnish constitution is the subject of one of the six chapters. The volume closes with author and subject indexes which make it most convenient in reference work.

WATER PURIFICATION

WATER TREATMENT. By *G. V. James.* Published by the Chemical Publishing Co., Brooklyn, N. Y. 224 pages. Price $12.

Reviewed by *Sheppard T. Powell*

THE AUTHOR has attempted to cover the entire field of water purification for industrial and sanitary uses and has included also a discussion of the treatment of domestic sewage. The text consists of 15 chapters and is divided into three parts. Part I is related to domestic water supplies, Part II to industrial supplies and effluents, and Part III to domestic sewage. It is obvious that this extensive field can only be very briefly reviewed in so small a text.

The point of view of the entire book is almost exclusively British or Continental. American research and developments are less prominently treated. The prints and illustrations are also British or Continental, and American design does not enter into these illustrations except to a limited extent.

An effort is made to mention all of the up-to-date water treating methods and to quote some authoritative source on these methods. The writer has presented fairly good general discussions on water softening and sterilization. Also, his development of the solubility of lead with the recognition of its toxic qualities is worthy of note.

Due to the limited size of the text, the subjects discussed are not presented as thorough-going studies or exhaustive inquiries. They are merely summaries or brief outlines.

The book will be found of less value to advanced students in the art of water and sewage treatment than to readers who desire to review this field quickly and in brief form. The comprehensive list of references which appears at the end of each chapter contributes much to the usefulness of the text and should greatly aid those who desire such bibliographies.

The illustrations have been well prepared and the text is clear and well organized.

PREDICTING REACTION RATES

THE THEORY OF RATE PROCESSES. By *Samuel Glasstone, Keith J. Laidler,* and *Henry Eyring.* Published by McGraw-Hill Book Co., New York, N. Y. 611 pages. Price $6.

Reviewed by *G. F. Kinney*

A NEW title for the International Chemical Series that attacks problems hitherto almost impregnable; problems of predicting specific reaction rates from fundamental principles. The attack is with methods of quantum mechanics and statistical mechanics, using data on physical properties of molecules such as interatomic forces, dimensions and configuration.

The theories and methods used, called the "theory of absolute rates," can be applied in principle to any process involving a rearrangement of matter and are not limited to the kinetics of chemical reactions. Considered in addition to chemical reaction rates is a study of the viscosity of liquids and solutions, the rates of liquid-liquid and solid-solid interdiffusion, the migration of ions, the phenomena of overvoltage, etc.

The method of calculation is based on the idea that a chemical reaction (or other rate process) is characterized by an initial configuration which passes over by continuous change of coordinates into the final configuration. There is always some intermediate configuration, called an "activated complex," which in general is

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situated at the highest point in the reaction path along the potential-energy surface. By finding the concentration and rate at which the activated complex passes through some critical stage it is possible to arrive at an absolute value for a specific reaction rate.

The data required for this calculation are largely spectroscopic, involving moments of inertia and normal vibration frequencies as well as the potential-energy surface for the reacting system. For a limiting ideal case the calculation is made without any experimental measurement of reaction rates. This ideal has actually been reached in a few instances.

The absolute rate method of attack gives results in many cases where the collision theory of chemical kinetics is quite inadequate. Even the absolute rate method is not always as good as desired, but calculated values are at least qualitatively correct and so represent a great advance.

One striking achievement of the theory of absolute rates is the theoretical calculation of liquid viscosity. Incidentally, the calculation of viscosity of molten metals involves the concept of metal ions flowing free of conductance electrons, and so reenforces modern ideas about the structure of metals. Then, too, it now becomes possible to predict with fair accuracy the influence of pressure on the viscosity of "normal" liquids.

The very subject matter of the book makes it one which must be studied rather than read. The chapter on quantum mechanics, for example, uses 239 mathematical equations. The book has, however, been written in such a way that omission of the mathematical details does not seriously interfere with an appreciation of the general method and results.

The text includes numerous charts, diagrams, and tables, and a large number of references to the original papers. It is a timely addition to the Series.

STAHLDRAHT. By *A. Pomp*. Published by Stahleisen, Dusseldorf, Germany. 275 pages. Price 17 marks.

Reviewed by *W. Trinks*

IN SPITE of war conditions, Stahleisen (the publishing department of the German Iron and Steel Institute) has undertaken the publication of an extended series of comparatively small books on well circumscribed subjects.

The first, on steel wire, has just been received. It begins with properties of the hot-rolled rod and ends with testing the finished wire. All intermediate stages and processes are described in detail. The book is a happy mixture of sound theory and advanced practice, as far as the latter has been released for publication. It may be remarked that Dr. Pomp is the outstanding German authority on the theory of wire drawing.

Those readers who are exceedingly well versed in the manufacture of steel

wire may possibly miss information on specialized details here and there, but the average reader will find his every question answered in theory, engineering, metallurgy and operation.

It is hardly necessary to review at length important chapters such as pickling, annealing, patenting, hardening, drawing, coating, testing; they are all good.

A translation of the volume, with slight modification by an American expert in steel wire, is very much to be desired. The modification is desirable because certain German trade names mean nothing to an American reader.

If the forthcoming books are as good as the first volume, they will make an interesting shelf of books for the steel industry.

THE PHOTOCHEMISTRY OF GASES. By *William A. Noyes, Jr.* and *Philip A. Leighton.* Published by Reinhold Publishing Corp., New York, N. Y. 475 pages. Prices $10.

NUMBER 86 of the A. C. S. Monograph Series, this volume presents a review of photochemical reactions in the gas phase. After an introductory chapter of definitions and laws, there are chapters on experimental technique, spectroscopy, and photochemical kinetics and the determination of mechanism. Approximately one-half of the book's pages deal with photochemical reactions following absorption by atoms or molecules. Extensive appendices summarize reactions.

PLASTICS IN INDUSTRY. By "Plastes". Published by Chemical Publishing Co., Brooklyn, N. Y. 234 pages. Price $5.

THE AUTHOR, evidently an Englishman, has prepared the text for "the industrialists of the world." Most of it is devoted to the applications for plastics in such industries as the electrical, building, aircraft, automobile, furniture, packaging, novelty, textile and chemical. As the author points out, the most important engineering constructional work with synthetic resins has taken place in the process industries. For several years fabricators in the United States, England and Germany have been producing a variety of equipment made from resins. The newest of these resinous products is a phenolic cast molding.

Synthetic resins for water softening is a new development in the treatment of water supplies. The advantages are discussed. The writer points out that possibly the greatest advantage is the ability of the resin to be adapted to suit almost any prevailing condition, and this is of considerable importance to both the engineer and the chemist.

The chapter on synthetic glues covers the development of this relatively new group of adhesives that is rapidly becoming important as an outlet for synthetic resins and to the users of glues. He discusses and compares the (1) urea formaldehyde; (2) solid urea formaldehyde resins; (3) phenol formaldehyde dry glue film;

(4) liquid phenolic resin; (5) cellulose cements; (6) acrylic; (7) vinyl.

The chapter on synthetic rubbers is interesting because of the burst of activity in this type of material in the United States at the present time. The properties of Koroseal, Thiokol, neoprene, Buna and other materials are covered. The chlorinated rubber products also come in for brief mention, emphasis being put on the molded products.

EXPERIMENTS IN ORGANIC CHEMISTRY. Second edition. By *Louis F. Fieser*. Published by D. C. Heath and Co., New York, N. Y. 488 pages. Price $2.80.

Reviewed by *R. H. McCormack*.

THIS very complete laboratory manual has been divided in this edition into two parts. Part I consists of 52 experiments well adapted for a thorough first course in organic chemistry. These experiments have been planned to keep the cost of chemicals at a minimum and a few of the time-honored preparations have been omitted because of the cost of the reagents required. Some of the general reactions are illustrated by aromatic compounds, instead of aliphatic, which provide a change from a succession of liquid reagents and liquid products.

"Part II constitutes a miscellany of notes on procedure and technique designed for the general guidance of advanced students." There is a fine section on glass blowing. A chapter on, "Solvents, Reagents and Gases," will help to clear up such difficulties as are presented by directions, "to work up the reaction mixture in the usual way." This second part of the book should be valuable as a technique guide for those unusual types of analysis which often find their way into commercial laboratories.

On the whole this is a very satisfactory laboratory manual, one which should free the instructor from the necessity of devoting a great deal of time to detailed instructions, and one which should help the student to acquire a good comprehensive laboratory technique.

GENERAL CHEMISTRY. Fourth edition. By *Harry N. Holmes*. Published by The Macmillan Co., New York, N. Y. 720 pages. Price $3.75.

REVISED to keep pace with advances in theory and application to industry, this popular elementary text presents modern theories and practices in a manner which will be found attrative by students encountering chemistry for the first time.

ELEMENTARY GENERAL CHEMISTRY. By *J. C. Hogg* and *C. L. Bickel*. Published by D. Van Nostrand Co., New York, N. Y. 603 pages. Price $2.12.

AN EXCELLENT book for the purpose for which it was written—a textbook for high schools and preparatory schools; up-to-date, accurate and well illustrated.

RECENT BOOKS and PAMPHLETS

Protecting Plant Manpower. Special Bulletin No. 3. Division of Labor Standards, U. S. Department of Labor, Washington, D. C. 70 pages. Gratis. Contains information on such industrial hygiene subjects as fatigue; criteria of industrial health hazards; preventive measures; heating, ventilation and cooling of work places; illumination; and noise. Elements of an industrial health program for the small plant are outlined.

Man Meets Job—How Uncle Sam Helps. By *P. S. Broughton.* Published by the Public Affairs Committee, New York, N. Y. 32 pages. Price 10 cents. Tells why the U. S. Employment Service was formed and how it functions in the present emergency.

Factors Affecting the Germicidal Efficiency of Hypochlorite Solutions. By *A. S. Rudolph* and *Max Levine.* Bulletin 150, Iowa State College Bulletin, Ames, Iowa. 48 pages. Gratis. Report of laboratory studies of effects of temperature, concentration, and reaction (pH) on germicidal efficiency of calcium hypochlorite.

The Determination and Examination of Light Oil in Gas. By *William L. Glowacki.* Published by American Gas Association, New York, N. Y. 40 pages. Publication of a paper presented last May before the A. G. A. Joint Conference in New York.

Bibliography of References to the Literature on the Minor Elements and Their Relation to Plant and Animal Nutrition. Second supplement to third edition. Originally compiled by L. G. Willis. Published by Chilean Nitrate Educational Bureau, New York, N. Y. 67 pages. A bibliography with abstracts of the publications listed. Indexed by authors, by elements, and by plants.

National Bureau of Standards Letter Circular 646. Prepared by I. A. Denison, of the Underground Corrosion Section of the Bureau. Underground behavior of various materials during exhaustive tests to determine their susceptibility to corrosion under service conditions is described. The bulletin discusses the significant features of various materials from the standpoint of their resistance to corrosion in soils and in other environments in which the same corrosive factors are present.

Who's Who in Engineering, 1941. Fifth edition. Edited by W. S. Downs. Published by Lewis Historical Publishing Co., New York, N. Y. 2107 pages. Price \$10. Containing biographical sketches and professional records of more than 15,000 engineers, this edition represents an increase of 25 percent over the previous edition which appeared four years ago.

British Plastics Year Book, 1941. Published by Plastics Press, Ltd., Ludgate Hill, London. 468 pages. Price 15 S. The usual listing of manufacturers of equipment, producers of materials, products and trade marks. Includes a review of progress during 1939 and 1940, also a "Who's Who" and a section on data and conversion of units.

Index — Transactions of the American Institute of Chemical Engineers. Published by the A. I. Ch. E., New York, N. Y. 41 pages. A subject index and an author index of the Transactions for the years 1924-1934; volumes XVI-XXX.

Medical Manual of Chemical Warfare. Published by Chemical Publishing Co., Brooklyn, N. Y. 119 pages. Price \$2.50. Reprinted from British publications intended for medical officers, the manual gives the effects of chemical warfare substances and methods of minimizing them.

Facts for Foundrymen. Fourth edition. By *E. G. Jarvis* and *H. O. Jarvis.* Published by Niagara Falls Smelting & Refining Corp., Buffalo, N. Y. 76 pages. Price \$1. A pocket-size durably bound book containing much miscellaneous information—composition, physical properties, abrasion and corrosion resistance, etc.—on many of the common metals and alloys.

Index to the Literature on Spectrochemical Analysis. Second edition. By *W. F. Meggers* and *B. F. Scriber.* Published by the American Society for Testing Materials, Philadelphia, Pa. 94 pages. Price \$1. Contains 1467 references. Papers are arranged in chronological order and in alphabetical order of authors; all titles are given in English.

Report of the National Research Council for the Year July 1, 1939–June 30, 1940. 96 pages. Describes the activities of the Council, its divisions and committees, including the Division of Chemistry and Chemical Technology.

Crystal Growth and Crystal Habit in Continuous Evaporators. By *P. H. Egli* and *C. L. Lovell.* Research Series No. 80, Engineering Experiment Station, Purdue University, Lafayette, Ind. 19 pages. Price 15 cents. Report of an investigation. Controlling factor for the size was the degree of supersaturation when the crystals, $MgSO_4.7H_2O$, were formed.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free and should be ordered from bureau responsible for its issue.

Glass Stopcocks, by Martin Shepherd. Bureau of Standards, Circular C430; 10 cents.

Typewriter Ribbons and Carbon Paper, by C. E. Waters. Bureau of Standards, Circular C431; 10 cents.

Structural Insulating Board (Vegetable Fiber). Bureau of Standards, Simplified Practice Recommendation R179-41; 5 cents.

Corrugated Fiber Boxes (Used by Department and Specialty Stores). Bureau of Standards, Simplified Practice Recommendation R128-41; 5 cents.

Color Marking for Anesthetic Gas Cylinders. Bureau of Standards, Simplified Practice Recommendation R176-41; 5 cents.

Classification of Acoustic Materials. Bureau of Standards, Letter Circular 633; mimeographed.

Publications on Acoustics by Members of the Staff of the National Bureau of Standards. Bureau of Standards, Letter Circular 636; mimeographed.

Sound Absorption Coefficients of the More Common Acoustic Materials. Bureau of Standards, Letter Circular 632; mimeographed.

Fire Tests of Structural Partitions, by S. H. Ingberg and N. D. Mitchell. Bureau of Standards, Building Materials and Structures Report BMS 71; 20 cents.

Welding. War Department, Technical Manual TM 1-430; 40 cents.

Defense Job Training. U. S. Office of Education, unnumbered chart. A condensed guide to programs authorized by Congress to train persons for work in defense industries and in the armed services.

Land Classification in the United States. National Resources Planning Board, unnumbered document; 60 cents.

Treating Spruce and Balsam Fir Christmas Trees to Reduce Fire Hazard. Forest Products Laboratory, Madison, Wisconsin, Technical Note No. 250; mimeographed.

Mathematical Tables. Several sets of mathematical tables are being sold by the Bureau of Standards. Remittance, payable to National Bureau of Standards, must be made in advance for these items. They are not to be ordered through Government Printing Office. Thus far available are: Table of the First Ten Powers of the Integers From 1 to 1000, MT1, 50 cents; Tables of the Exponential Function, MT2, \$2.00;

Tables of Circular and Hyperbolic Sines and Cosines for Radian Arguments, MT3, $2.00; Tables of Sines and Cosines for Radian Arguments, MT4, $2.00; Tables of Sine, Cosine, and Exponential Integrals, Vol. 1, MT5, $2.00; Tables of Sine, Cosine, and Exponential Integrals, Volume II, MT6, $2.00.

Statistical Classification of Imports into the United States, with rates of duty and regulations governing the preparation of monthly, quarterly, and annual statements of imports, effective January 1, 1941. Bureau of Foreign and Domestic Commerce, Schedule A; 50 cents.

Foreign Commerce. Under date of May 29, 1941, subscribers to foreign trade export statistical statements, issued by the Department of Commerce, showing country of destination, were notified that all statements showing U. S. exports by country of destination would be discontinued with the data for March, 1941. To avoid a break in general export data, on a commodity basis, attention is invited to Monthly Summary of Foreign Commerce of the U. S., Subscription $1.25 per year, single copies 15 cents.

Prime Movers, Generators and Motors; Electric Energy Consumed—Country as a Whole and 33 Industrial Areas. Bureau of the Census, Census of Manufactures, 1939, Preliminary Report, August 5, 1941; mimeographed.

Production Statistics from the Census of Manufactures. Printed pamphlets from the 1939 Census of Manufactures on Electrical Machinery; 10 cents.

Research Projects Reported for Inclusion in Business Research Projects, 1941, Relating to Problems of National Defense. Department of Commerce, unnumbered mimeographed document, released August 8, 1941.

List of Available Publications of the United States Department of Agriculture, January 2, 1941. Department of Agriculture, Miscellaneous Publication No. 60, Revised, 1941; available from Department of Agriculture without charge.

List of the Agricultural Periodicals of the United States and Canada Published During the Century July 1810 to July 1910. Department of Agriculture, Miscellaneous Publication 398; 20 cents.

Fire-Retardant Paints Containing Borax. Forest Products Laboratory, Madison, Wisc., Technical Note No. 249; mimeographed.

Investigations on the Storage of Nuts, by R. C. Wright. Department of Agriculture, Technical Bulletin 770; 5 cents.

The Internal Application of Chemicals to Kill Elm Trees and Prevent Bark-Beetle Attack, by R. R. Whitten. Department of Agriculture, Circular No. 605; 5 cents.

Peat Resources in Alaska, by A. P. Dachnowski-Stokes. Department of Agriculture, Technical Bulletin 769; 15 cents.

Carbonizing Properties and Petrographic Composition of No. 1-Bed Coal From Bell No. 1 Mine, Sturgis, Crittenden County, Ky., and the Effect of Blending This Coal with Pocahontas No. 3- and No. 4-Bed Coals, by J. D. Davis and others. Bureau of Mines, Technical Paper 628; 10 cents.

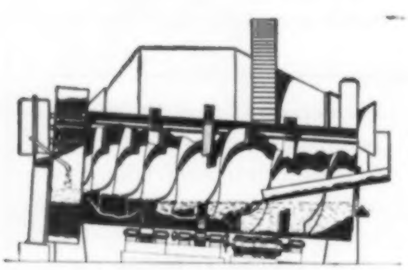
Cooperative Fuel Research Motor-Gasoline Survey, Winter 1940-41, by E. C. Lane. Bureau of Mines, Report of Investigations 3576; mimeographed.

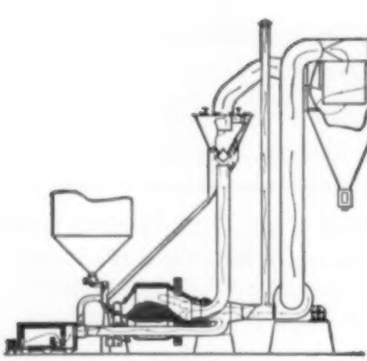
Asphalts From Some Wyoming and Other Asphalt-Bearing Crude Oils, by K. E. Stanfield. Bureau of Mines, Report of Investigations 3568; mimeographed.

Survey of American Listed Corporations—Vol. VII, including Reports Nos. 48 to 52 inclusive on Railroad Equipment, Radio and Radio Equipment, Nonferrous Metals and Their Products, Electrical Supplies and Equipment, and Commercial Cars and Trucks. Available from Securities and Exchange Commission, Washington, D. C.

Index of the United States Army and Federal Specifications Used by the War Department, January, 1941. War Department, unnumbered document; 25 cents.

Review and Criticism on Behalf of Standard Oil Co. (New Jersey) and Sun Oil Co. of Monograph No. 39 with Rejoinder by Monograph Author. Temporary National Economic Committee, Investigation of Concentration of Economic Power, Monograph No. 39-A; 15 cents.





MANUFACTURERS' LATEST PUBLICATIONS

Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterhead.

Alcohol. U. S. Industrial Chemicals, Inc., 60 E. 42nd St., New York, N. Y.—10-page folder entitled "The Story of Industrial Alcohol" which gives production processes for alcohol in descriptive and flow-sheet form, details of applications, including a handy chart, Government regulations on the purchase and use of industrial alcohol, and other useful information.

Brazing Alloys. Handy & Harman, 82 Fulton St., New York—Bulletin 12—16-page folder on low-temperature brazing of metals with this concern's silver brazing alloys "Sil-Fos" and "Easy-Flo". Includes descriptive material, photographs illustrating applications, and useful engineering data.

Centrifuges. The Clay-Adams Co., Inc., 44 E. 23rd St., New York—Catalog 111—16-page bulletin featuring this concern's line of centrifuges with illustrations, descriptions, and prices of all models. Includes data on types recently developed.

Conduit System. H. W. Porter & Co., Inc., Newark, N. J.—Bulletin 381—8-page folder illustrating and briefly describing this concern's steam conduit systems for protection, support and installation of underground pipelines.

Control Equipment. The Bristol Co., Waterbury, Conn.—Bulletins 511, 512 and 534—Bulletins on this concern's system of coordinated process controls for temperature, pressure, vacuum, draft, liquid level, pH and similar operations in various branches of industry.

Control Equipment. The Brown Instrument Co., Wayne & Roberts Aves., Philadelphia, Pa.—Catalog 8903—36-page catalog on this concern's air-operated controllers for temperature, pressure, flow, liquid level and humidity. Includes illustrations of each unit, diagrammatic sketches showing principles of operation, brief descriptive matter, data on accessories, and sketches showing mounting dimensions.

Control Equipment. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia, Pa.—Bulletin N96-709D—16-page illustrated booklet on this concern's automatic pH control apparatus. Describes and illustrates in detail use of this equipment in the paper industry to control the pH of paper stock by regulating the addition of alum or other reagents.

Control Instruments. The Permochart Co., Sewickley, Pa.—Bulletin 141—2-page folder on this concern's circular recording meter charts in three colors made of vinylite plastics so that ink can be removed and the chart re-used.

Dust Collectors. Pangborn Corp., Hagerstown, Md.—Bulletin 907—6-page folder illustrating and briefly describing this concern's unit type dust collectors for various purposes. Includes diagrammatic sketches.

Electrical Equipment. Keystone Carbon Co., Inc., 1935 State St., St. Marys, Pa.—4-page folder which describes and gives engineering data on this concern's negative temperature coefficient resistant materials for reducing or eliminating initial current surge in electrical equipment.

Electrical Equipment. The Stearns Magnetic Mfg. Co., Milwaukee, Wis.—16-page catalog on this concern's magnetic pulleys and magnetic pulley separator units. Contains descriptive matter, illustrations, specifications, application and other data.

Equipment. Abbe Engineering Co., 50 Church St., New York—Bulletin 52—8-page folder which illustrates, describes briefly, and gives specifications of this concern's "Blutergess" turbine sifter. Also Bulletin 53, 2-page sheet which illustrates and describes briefly change-can mixers, including specifications.

Equipment. The B. F. Goodrich Co., Akron, Ohio—Catalog Section 7900—12-page section on this concern's vibration insulators which includes illustrations, detailed drawings, tables of characteristics, applications and discussion of selection and mounting.

Equipment. The Carrier Corp., Syracuse, N. Y.—Bulletin 9SQR-1—12-page folder on heat disposal from air conditioning and refrigeration which outlines the theory, operation and principal features of this concern's line of evaporative condensers. Includes diagrammatic drawings and photographs.

Equipment. The Drever Co., 748 E. Venango St., Philadelphia, Pa.—Bulletin B5—4-page folder illustrating and describing briefly this concern's ammonia dissociation equipment to provide a protective atmosphere for metal-treating furnaces and a source of supply of hydrogen and nitrogen.

Equipment. Johnstone Engineering & Machine Co., Downingtown, Pa.—Bulletin 641—4-page folder on this concern's uniform tension unwinders with auto-hydraulic brakes for use with paper, fabric, rubber, etc. Illustrates and describes briefly operating principles and outstanding features.

Equipment. Syntron Co., Homer City, Pa.—Catalog 416—48-page catalog on this concern's vibratory materials handling equipment including information in photographic, descriptive, and diagrammatic form on vibrators, conveyors, feeder machines, constant weight feeders, and similar equipment.

Flowmeters. Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa.—Publication 3010—52-page handbook on this concern's flowmeters for steam, water, air, gas and viscous, volatile and corrosive fluids. Describes important operating details of various types of instruments, construction features, specifications and other useful information.

Furnaces. American Arch Co., Inc., 60 E. 42nd St., New York—Catalog 200—56-page bound booklet on this concern's furnace designs, including sectionally-supported walls, suspended boiler arches, and suspended arches for heavy duty furnaces. Contains numerous detailed engineering drawings of the various designs, brief descriptions of each and useful information on various types of walls and arches for boilers, cement mills, glass furnaces, reverberatory furnaces and others.

Lathes. South Bend Lathe Works, 398 E. Madison St., South Bend, Ind.—Catalog 50B—56-page catalog on this concern's 9-in. precision lathes, with information on use and selection of the company's 27 different types and their attachments, tools and accessories.

Lighting Equipment. The Thompson Electric Co., 1101 Power Ave., Cleveland, Ohio.—Catalog 41—40-pages on this concern's hangers, shock absorbers, suspension devices, and other accessories and fittings for lighting purposes. Includes photographs, brief description, and size and specification data.

Magnetic Separators. Dings Magnetic Separator Co., 509 E. Smith St., Milwaukee, Wis.—8-page bulletin entitled "Magnetic Mineralogy" which illustrates and describes various magnetic separators put out by this concern. Includes discussion of applications, outstanding features, and photographic illustrations of various industrial units.

Magnetic Separators. S. G. Frantz Co., Inc., 161 Grand St., New York—

Bulletin 20—8-page folder on this concern's "Ferrofilters" for magnetically removing iron and steel particles from suspensions in liquids. Includes illustrations, brief description of operating features, applications in various industries and dimension specifications.

Magnetic Separators. Magnetic Engineering & Mfg. Co., Clifton, N. J.—Catalog 541—8-page catalog on this concern's induction type separators for concentration of feebly magnetic ores, reduction of iron oxide content of silica and other materials, and for other uses. Includes discussion of new features of design, principles of operation, typical applications, dimension tables, and illustrations.

Machinery. Morse Bros. Machinery Corp., P.O. Box 1708, Denver, Colo.—Stock List 4101—32-page catalog on this concern's reconditioned machinery such as electric motors, generators, crushers, filters, flotation machines, boilers, and other machinery. Includes illustrations and detailed specification of each unit. Also Bulletin T-41, 4-page folder on reconditioned concentrating tables of the Wilfley and Deister Platt-O type.

Materials. Continental-Diamond Fibre Co., Newark, Del.—8-page folder entitled "What Material" designed to help engineers select proper type of nonmetallic material for a specific problem. Includes data on this concern's products of laminated plastics, vulcanized fiber, mica and mascerated base plastics, including a wall chart giving data on the company's materials for various uses.

Metals. Ampco Metal, Inc., 1745 S. 38th St., Milwaukee, Wis.—Catalog 22—24-page booklet describing this concern's alloy of the aluminum bronze class, including descriptions of the various alloys, tables of physical properties and range of chemical composition. Illustrated with photomicrographs.

Metals. Metallizing Engineering Co., Inc., Long Island City, N. Y.—16-page discussion on "How to Get Along With Less Priority Metal" by the use of this concern's metal spraying process, especially in the production and maintenance of rotating and reciprocating mechanisms.

Metal Treatment. A. F. Holden Co., New Haven, Conn.—8-page folder entitled "Ten New Ways to Save Time and Labor with Holden Heat-Treating Baths" which describes briefly this concern's baths for various heat-treating purposes and also hot furnaces for heat-treating applications.

Metals Treatment. General Electric Co., Schenectady, N. Y.—Bulletin GES-2722—8-page bulletin on this concern's "Drycolene", a gas for furnace atmospheres to prevent decarburization of steels during treatment. Includes illustration of applications, flow diagrams of a Drycolene producer, and detailed discussion of properties and distinctive features.

Metals Treatment. Handy & Harman, 82 Fulton St., New York, N. Y.—8-page bulletin entitled "The Best Joint Design for Silver Alloy Brazing". Gives comprehensive discussion of the subject and includes photographic illustrations of operations, cross-sectional drawings of various joint designs, and engineering data in chart and text form.

Metals Treatment. Metallizing Co. of America, Inc., 562 W. Washington Blvd., Chicago, Ill.—54-page booklet entitled "The History, Purpose and Practice of Metallizing", giving technical and general information on metal spraying and its applications in various industries.

Metal Coatings. The Truscon Laboratories, Inc., Detroit, Mich.—Bulletin 518—4-page pamphlet on this concern's new rubber-base metal coatings for use on all types of exposed iron and steel as well as aluminum, copper and galvanized metal. Includes general information on properties, uses for various purposes, and distinctive features.

Odor Adsorber. W. B. Connor Engineering Corp., Dorex Div., 114 E. 32nd St., New York—Bulletin 112—6-page folder describing this concern's line of unit odor adsorbers with illustrations and data on dimensions and capacities.

Optical Instruments. Spencer Lens Co., Buffalo, N. Y.—26-page booklet on this concern's polarizing microscope for petrographic, chemical and general laboratory purposes, including data and prices for accessories. Discusses general principles and importance of the microscope, uses for various industrial purposes and gives description, illustrations, specifications and prices for the various types and models. Also 32-page booklet giving principles, description, and detailed information on the use of this concern's new type polarimeter for various purposes. Also four-page pamphlet describing and illustrating briefly principles and uses of this new polarimeter which uses a special Polaroid device instead of calcite prisms.

Packings. Johns-Manville, 22 E. 40th St., New York, N. Y.—Form PK-12A—44-page catalog on this concern's packings and gaskets, containing service recommendations, detailed information on styles, selection tables and other similar information.

Paints. Hercules Powder Co., Wilmington, Del.—Form 5003—16-page pamphlet on concrete paints made with this concern's chlorinated rubber. Describes briefly and illustrates uses of this concrete finish for various purposes.

Piping. The Crane Co., 836 S. Michigan Ave., Chicago, Ill.—Bulletin 1—6-page folder, the first of a series containing practical suggestions on how to eliminate or reduce interruptions to plant operations, to train new men in the handling of piping equipment, and to get longer service under peak load conditions, and method for selection of valves and fittings for various services.

Pumps. Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago, Ill.—Bulletin 6720X—4-page folder illustrating and briefly describing this concern's horizontal short-coupled motor-driven pumps, including data on principal dimensions, sizes and ratings.

Pumps. Pacific Pump Works, Huntington Park, Cal.—Bulletin 78—12-page bulletin describing and illustrating principal features and applications of this concern's single-stage process type "SV" centrifugal pump, including diagrammatic cross-sectional and dimensional views.

Pumps. Worthington Pump & Machinery Corp., Harrison, N. J.—Bulletin W-304-B2—4-pages on this concern's "Type U" 2-stage volute centrifugal pump, including information on construction features, specifications, and dimensions; also Bulletin W-483-B1, 12-page booklet on rotary pumps with double-helical gears. Includes illustrations, specifications, data on applications, sizes, ratings, and outstanding features. Also Bulletin S-550-B19, 18-pages on the "LFC" type angle gas engine-compressor, with illustrations, dimensions and specifications.

Rotameters. Fischer & Porter Co., Hatboro, Pa.—Section 50-A—8-page pamphlet on this concern's electrically operated, remote indicating, recording and integrating rotameters, with drawings showing construction features and wiring diagrams, photographs, and discussion of principal operating and construction features.

Steels. Allegheny Ludlum Steel Corp., Oliver Building, Pittsburgh, Pa.—Two manuals on high-alloy steels of interest to students and instructors in trade and engineering schools, army and navy forces, and industrial defense courses. One manual deals with tool steels while the other treats of stainless steels, and data includes methods of analyses, treatment and basic uses of alloys discussed and general information on the working and uses of special steels.

Steels. Hadfields, Ltd., East Hecla and Hecla Works, Sheffield, England.—Bulletin 446—14-page bulletin on this concern's steels of high-creep strength for use at temperatures up to 550 deg. C. Includes tables giving physical and mechanical properties and stability to heat treatment of carbon-molybdenum steel and chromium-molybdenum steel, together with discussion of working procedures and general applications.

Steels. Jessop Steel Co., Washington, Pa.—Bulletin 341—8-pages on this concern's "3C" high-carbon high-chrome die steel. Includes brief discussion of

forging, annealing, hardening, tempering, resistance to corrosion and oxidation, applications, and charts of engineering data on tempering range, coefficient of expansion and other properties. Also bulletin 441, six-page pamphlet on "C.N.S." high-carbon high-chrome die steel. Includes general discussion of forging, annealing, and other properties both in descriptive and chart form.

Testing. The Refinery Supply Co., Inc., 621 E. 4th St., Tulsa, Okla.—Folder discussing briefly concern's geologist staining set for calcite and feldspar and also small folder on the concern's free chlorine color standard set for testing water.

Testing Machines. Baldwin Southwark Div., The Baldwin Locomotive Works, Philadelphia, Pa.—Form 161—40-page booklet on this concern's testing machines and allied equipment for loading, weighing, indicating and other operations. Includes description, photographs of actual installations and engineering data on the units.

Thermocouples. Wheelco Instruments Co., Harrison & Peoria Sts., Chicago, Ill.—Bulletin S2-3—32-page data book and catalog on this concern's thermocouples, thermocouple wires, protecting tubes, connectors, and other thermocouple accessories. Contains extensive engineering data, detailed descriptions, prices and selection tables.

Tools. Bonney Forge & Tool Works, Allentown Pa.—Catalog No. 41—104-page catalog covering the line of this concern's tools, including 1,169 individual tools and 74 complete tool sets. Includes illustrations, description and specifications for wrenches of various types, pliers, hack-saws and blades, gages, chisels, and other such tools as well as a large assortment of specialized tools.

Tower Packing. The United States Stoneware Co., 60 E. 42nd St., New York—Bulletin 51—8-pages on this concern's Tower packings, including Raschig rings, spiral packing rings, cross-partition rings, packing cones, grid tile, Lessing rings, ceramic balls. Includes specification data for each type, diagrammatic sketches and engineering data on resistance of tower packings to gas flow and tower sections.

Transformers. Wagner Electric Corp., 6400 Plymouth Ave., St. Louis, Mo.—Bulletin TU34—4-page bulletin on this concern's new protected rural line transformers, with illustrations and general description of operating principles and advantages.

Valves. Hills-McCanna Co., 3025 N. Western Ave., Chicago, Ill.—1941 catalog on this concern's diaphragm type valves, with illustrations and text material on outstanding features, specifications, service recommendations, and other factual data.

Wash Fountains. Bradley Washfountain Co., 2203 W. Michigan St., Milwaukee, Wis.—24-page booklet illustrating installations and actual use of this concern's washfountain and multi-stall showers for use in industrial plants.

Water Treatment. Cochrane Corp., 17th St. and Allegheny Ave., Philadelphia, Pa.—Publication 3006—12-page booklet giving fundamental reactions involved in water softening, with particular attention to "ionic analysis" and "equivalents per million" methods of interpreting water analysis. Includes chemical equations, conversion factors, and methods of calculation; also Publication 3015, 6-page folder describing briefly and illustrating concern's electrical controls for proportional chemical feeders for water conditioning equipment, including details of proportioner design, flow diagrams, and other data.

Waterproof Clothing. Goodall Rubber Co., 5 S. 36th St., Philadelphia, Pa.—Catalog 203.—12-page catalog on this concern's waterproof boots, hats, aprons, gloves, blankets and other clothing for industrial purposes.

Welding. Air Reduction Sales Co., 60 E. 42nd St., New York City—First issue of this concern's house organ entitled "Airco in the News" which gives information, mostly in the form of illustrations, on oxy-acetylene welding.

CONSUMPTION OF CHEMICALS RISES IN DEFENSE PLANTS, DECLINES IN CIVILIAN INDUSTRIES

Chem & Met ECONOMICS and MARKETS

While seasonable influences have entered somewhat into the reasons underlying the drop in consumption of chemicals in the non-defense industries, the routing of materials in increasing volume to the so-called essential lines of manufacture is of more importance especially as it promises to be more than temporary. Actually, production of chemicals is going ahead at a record rate and is moving to consumer industries as fast as turned out which means that production and consumption are in fair balance. In the direct defense industries a wide variety of chemicals are required. This includes the manufacture of munitions, gases, airplanes, aluminum, magnesium, etc. Data regarding the month-to-month progress of these industries is for the most part a matter of secrecy. Hence it is both undesirable and difficult to include these industries, either separately or in toto, in the index for consumption. The *Chem. & Met.* index, therefore, refers to industrial consumption not including defense plants operations.

Chem. & Met. Index for Industrial Consumption of Chemicals

	June revised	July
Fertilizers	29.04	28.50
Pulp and paper	22.00	22.20
Petroleum refining	15.10	15.78
Glass	15.55	14.60
Paint and varnish	17.64	15.90
Iron and steel	13.04	13.13
Rayon	11.94	12.40
Textiles	10.64	11.37
Coal products	9.16	9.33
Leather	4.92	5.06
Explosives	5.76	5.02
Rubber	4.69	4.05
Plastics	3.60	3.70
	163.08	161.04

The preliminary index for consumption of chemicals for August is 160 which compares with a revised number of 161.04 for July and 163.08 for June. Last year the corresponding index numbers were 144.96, 136.57, and 137.86 respectively.

As more and more chemicals are restricted by priorities and allocations, the government becomes increasingly important as a governor of distribution. Actually it now appears that the new OPM organization will be virtually a dictator of uses.

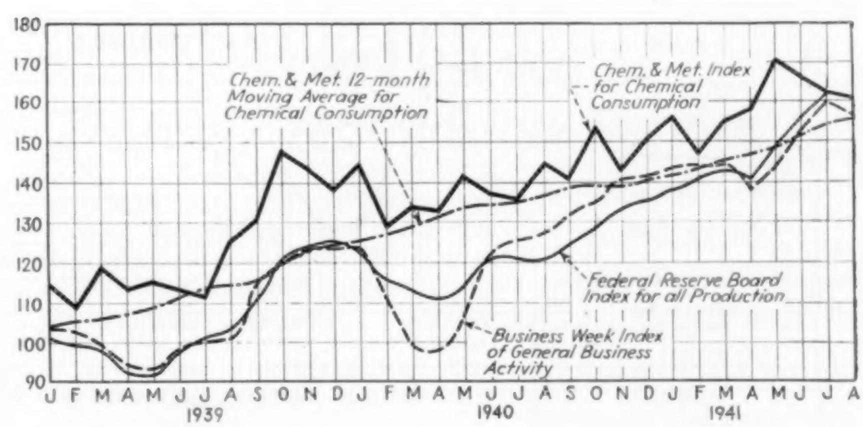
This has important implications for all users of chemicals. There is hardly an enterprise into which the rules of the new agency will not reach sooner or later. It is very necessary that each consumer be prepared to justify his chemicals requirements.

In some cases the new set-up is going to compel a new program of chemical usage. Sometimes the new program will consist merely of acceptance of new raw materials or new types of manufacturing which will make unnecessary normal requirements for chemicals that are scarce. Often the shift will have to be more fundamental than this. It may require a complete change in the present manufacturing, using old facilities to make new things either for the same old customers or for new and urgent defense purposes. Or it may mean that a manufacturer may have to change his distribution from the normal service to civilian activities. In such case, cutting off of old customers will not be pleasant. But it may be essential in order to justify continued operation of manufacture.

In still other cases there will be shut-downs in customer industries that will cut off uses of the past. For example, any firm that has been selling commodities to stove makers, refrigerator builders, or manufacturers of many other household devices may find that their customers are running at half speed or less very soon. The chemical requirements will be correspondingly reduced. This is the reason why ordinary industrial consumption is declining and probably will drop still further as shortages increase.

All this means a recasting of process industry plans. All this means that every effort must be made to keep closely in touch with changing Washington policy. All this means that the greatest of administrative agility will be necessary if process industry is to stay on its feet and not be trampled in the stampede, as we change over to a complete war-time economy.

Producers, dealers and purchasers of industrial solvents have been asked by Office of Price Administration, not to raise prices on these chemicals above the July 29, 1941, level without prior consultation with its office. Price schedules are now being prepared for a number of these products. It is unlikely that the schedules will be above July 29 prices and in some cases may be lower than prices then prevailing.

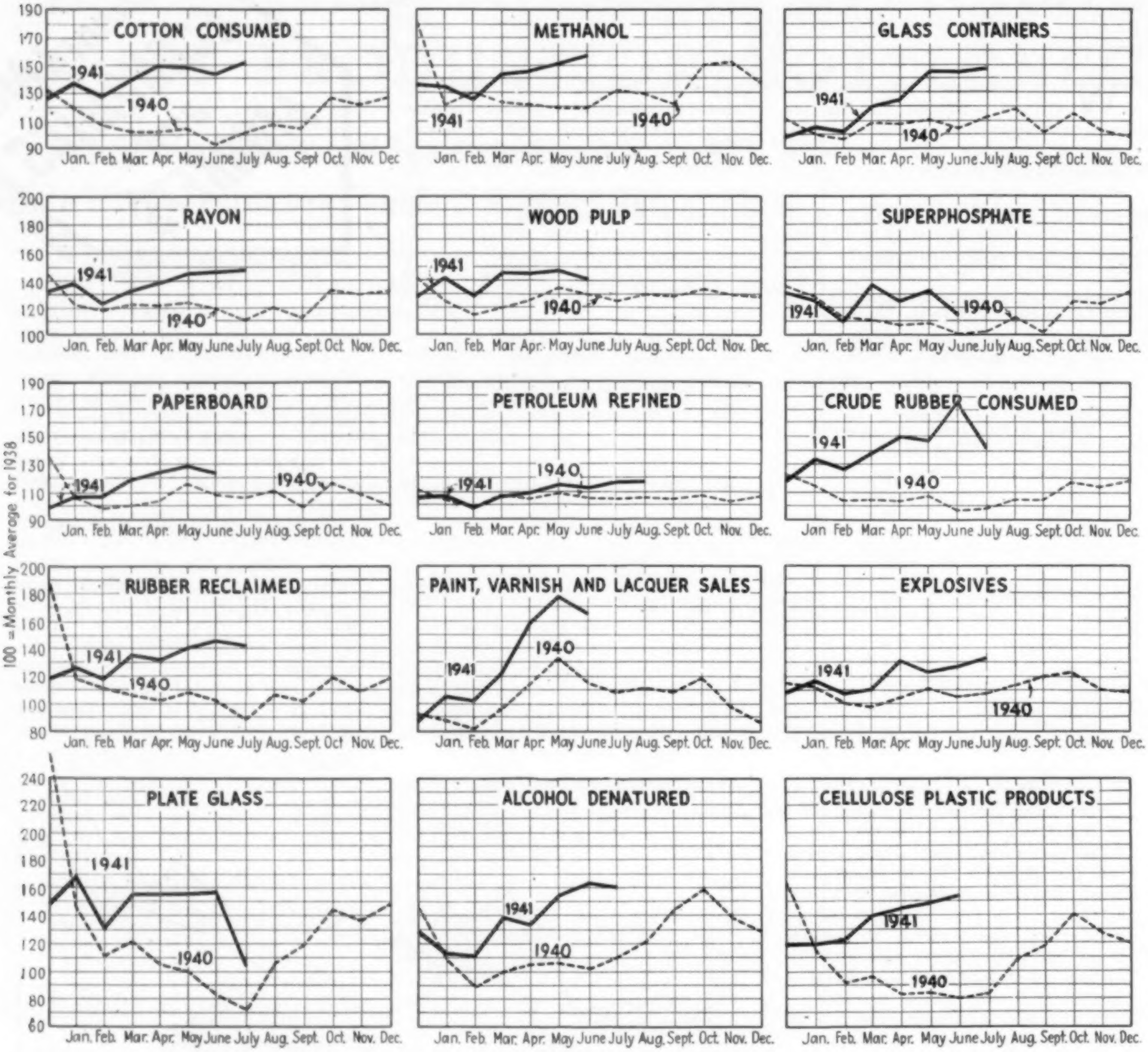


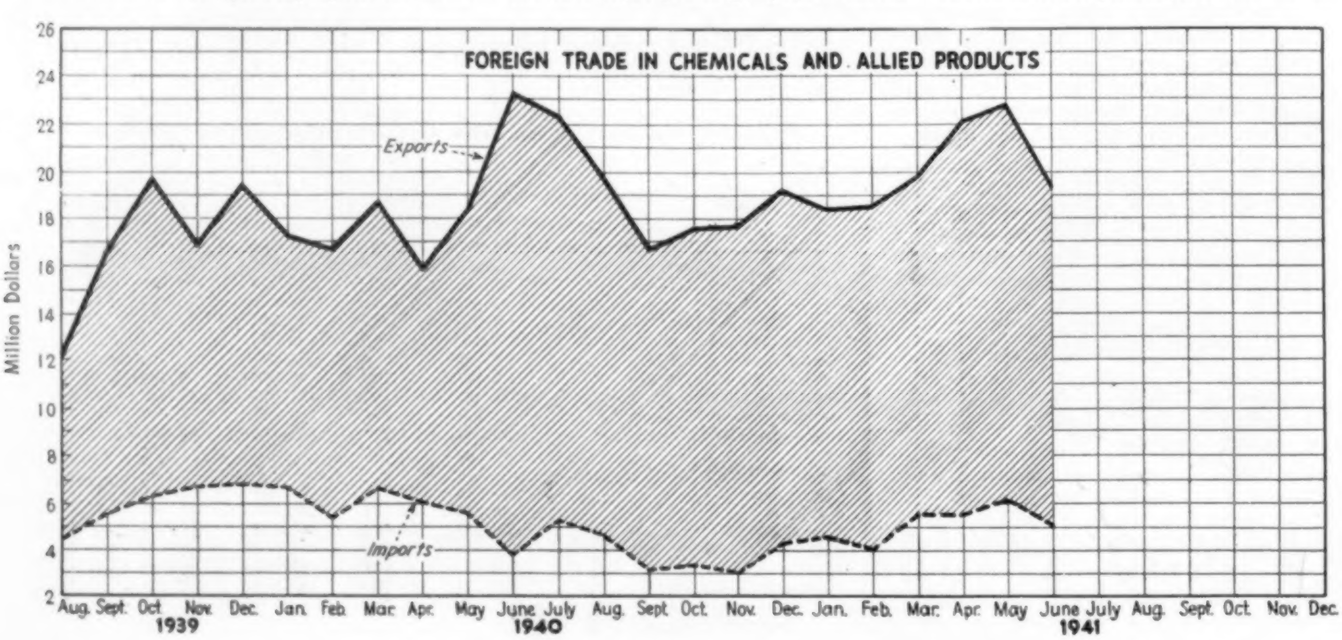
Production and Consumption Data for Chemical-Consuming Industries

Production	July 1941	July 1940	January–July 1941	January–July 1940	Percent of gain for 1941
Alcohol, ethyl, 1,000 pr. gal	33,021	22,457	192,548	147,062	38.9
Alcohol denatured, 1,000 wi. gal	15,241	10,442	92,354	68,562	34.7
Ammonia liquor, 1,000 lb.[1]	5,475	4,739	36,903	31,848	15.9
Ammonium sulphate, tons [1]	62,585	60,306	430,940	402,007	7.2
Benzol, 1,000 gal [1]	11,403	11,751	84,900	73,967	14.8
Byproduct coke, 1,000 tons	5,014	4,632	33,604	30,157	11.4
Toluol, 1,000 gal [1]	2,534	....	16,511	....	....
Naphthalene, 1,000 lb [1]	7,742	....	48,085	....	....
Glass containers, 1,000 gr	6,291	4,780	38,038	31,486	20.8
Plate glass, 1,000 sq. ft	12,463	8,522	121,016	87,127	38.9
Window glass, 1,000 boxes	1,281	994	9,642	7,612	26.7
Rubber reclaimed, tons	23,111	14,299	153,175	119,256	28.4
Consumption					
Cotton, bales	928,943	622,723	6,134,203	4,473,631	37.1
Silk, bales	28,528	22,766	181,121	154,486	17.2
Wool, 1,000 lb	58,085	34,472	361,294	202,148	78.7
Explosives, 1,000 lb	41,273	33,340	256,043	228,810	11.9
Rubber, crude, tons	68,653	48,354	493,831	365,655	35.1
Rubber reclaimed, tons	21,725	14,539	143,583	110,429	30.0

[1] Byproduct coke production

Production and Consumption Trends





PRIORITIES AND PRICE CONTROLS ARE MORE IMPORTANT AS FACTORS IN THE MARKET FOR CHEMICALS

PLACING chemicals under full mandatory control by the Priorities Division of OPM is becoming increasingly important in the market for these products and not only affects open trading, accentuates the scarcity of many chemicals, and governs a good part of distribution, but also because of the implication which this procedure has in the way of forecasting limits to production in several fields where chemicals are necessary raw materials. The first chemicals to be given priority status were borax and boric acid and the original order was later extended to cover deliveries through August and now it is announced that trading in these chemicals is unrestricted. In the last month the number of chemicals placed under control was rapidly expanded. The list now includes chlorine, formaldehyde, paraformaldehyde, hexamethylene tetramine, polyvinyl chloride, synthetic rubbers, chlorinated hydrocarbon refrigerants, alcohol, acetone, potassium perchlorate and permanganate, toluol, tricresyl and triphenyl phosphates, phenols, and phosphorus oxychloride.

Because producers of chemicals have held price advances to a minimum and as far as possible have controlled distribution so as to discourage speculative trading, there has been no call for extensive government price controls but ceiling prices have been established for formaldehyde and requests have been made to stabilize prices for other chemicals as in the case of ammonium sulphate. Small-lot trading in the spot market however, has taken advantage of the supply situation by pushing prices far above the sales schedules maintained by producers. It is possible that some control over this situation will come into effect but some of the smaller consumers of chemicals are unable to obtain stocks from first hands and maintain it is preferable for them to obtain supplies at any price rather than to close their establishments.

The weighted index for chemical prices continued its slow advance in the interval with spirits of turpentine attracting attention because of the daily fluctuations. The market gained strength last month on reports of smaller production and because of rather heavy buying for shipment to Great Britain. Rosins lagged behind turpentine but effective Aug. 30, CCC announced that offerings of 1940 loan rosin would be withdrawn from the market and this had a bullish effect.

Prices for oils and fats resumed their upward movement during the month and closed at the highest levels for the year. Rumors have been rife regarding price limits for some of the vegetable oils but such action has not yet been taken. However, an order came from OPACS which proclaimed that purchases of fats and oils purely for the purpose of speculative resale are prohibited. It further stipulated that deliveries against forward purchases must be completed within 45 days of commitment but this did not include sales of crude oils by producing mills or to the sale of imported oils. When this order first became public it created considerable confusion because, while it excepted trading on organized commodity exchanges, it was open to the interpretation that even the sale of futures must be confined to actual consumers. The New York Produce Exchange which is the official trading center for refined cottonseed oil closed the oil ring on Aug. 29 pending clarification of the order. Trading was resumed when it was found that the restraining order referred only to purchases of the actual oil and not to futures.

Estimate for the flaxseed crop as of Sept. 1, placed prospective yield at 31,900,000 bu. compared with 31,217,000 bu. the final for 1940.

Increased transportation rates are going to place new burdens on superphosphate. This is the inevitable result of transfer from water to rail of the movement of phosphate rock and sulphur.

Interstate Commerce Commission rulings have been issued attempting somewhat to alleviate this situation. ICC has granted approval to the railroads for a rate of \$4.50 per ton to Norfolk for phosphate rock and the order authorizes a charge of not more than 50 cents greater for the Baltimore destination. Old water rates were \$2.00 to Baltimore and \$2.50 to Norfolk. Thus superphosphate will cost from \$1.00 to \$1.50 more per ton because of the necessity for rail haul of the rock.

ICC has also favored sulphur for carlot rates to certain acid-making destinations. But the new sulphur rates by rail would normally be prohibitively higher than water rates. Even under most favorable conditions it is expected that the increase will be at least 50 cents per ton.

Recent official figures showed a production of iron pyrites in Spain of

CHEM. & MET.

Weighted Index of

CHEMICAL PRICES

Base=100 for 1937

This month	**103.42**
Last month	102.91
September, 1940	98.68
September, 1939	97.12

Producers continue to hold prices for most chemicals on an unchanged level but whatever changes take place are on the up side and a slowly rising trend is in evidence. Turpentine was especially prominent in the recent price movement.

104,722 tons during the first 4 months of 1941, but no figures are available on production of copper pyrites. Late in June two Spanish vessels cleared from Spanish ports with approximately 16,000 tons of copper pyrites for the United States, but, the first of July, one of the vessels was being held at Gibralter on instructions from the Spanish Government. Substantial purchases of copper and iron pyrites from the Spanish- and French-owned mines have been made for shipment to Germany.

Imports of pyrites into the United States from Spain during the first 5 months of 1941 amounted to 26,500 tons, valued at $69,000, representing only 30 percent of the total imports of pyrites during the 5-month period. Spain supplied 80 percent of the pyrites imported during the entire year of 1940, or 325,600 tons valued at $790,200, and 50 percent of the total imported in 1939, or 282,700 tons valued at $738,400.

The three projects for the manufacture of acetic acid in Argentina are still in a preliminary stage, since considerable difficulty has been encountered in starting production. One of the three firms is affiliated with a French company manufacturing rayon yarns locally.

The United States exported to Argentina 546,900 pounds, valued at $40,500, of acetic acid (100 percent) and 55,000 pounds, valued at $6,600, of acetic anhydride in 1939, and 212,000 pounds, valued at $16,200, of acetic acid and 6,900 pounds, valued at $900, of the acetic anhydride in 1940.

Deposits of bauxite and sulphate of aluminum existing in the coastal valleys of Peru from the Santa River Valley in the Department of Ancash to the Chancay Valley in the Department of Labayeque are reserved for the State by resolution dated July 7, 1941.

Another decree of the same date declared deposits of bauxite and natural alums in any form to be considered as mining property in accordance with the dispositions of the Mining Code. The prologues of the two decrees state that it is necessary to conduct investigations to determine the possibilities of exploiting the minerals, in view of the current demand in the mining and metallurgical industries.

CHEM. & MET.

Weighted Index of Prices for

OILS & FATS

Base=100 for 1937

This month	**127.37**
Last month	122.80
September, 1940	67.43
September, 1939	84.27

Regulations bearing on the sale of oils had no effect in the way of checking the rising price trend. Crude cottonseed oil was a leader and other oils fell into line. Animal fats also were higher with good buying interest in tallow for soap account.

Chem & Met Current PRICES

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb	$0.08½–$0.09	$0.08½–$0.09	$0.07½–$0.08
Acid, acetic, 28%, bbl., cwt	3.18 – 3.43	3.18 – 3.43	2.23 – 2.48
Glacial 99.5%, drums	8.68 –10.00	8.68 –10.00	8.43 – 8.68
U. S. P. X1, 99.5%, dr	10.50 –11.00	10.50 –11.00	10.25 –10.50
Boric, bbl., ton	106.00–111.00	106.00–111.00	106.00–111.00
Citric, kegs, lb	.20 – .23	.20 – .23	.20 – .23
Formic, cbys., lb	.10½– .11	.10½– .11	.10½– .11
Gallic, tech., bbl., lb	1.05 – 1.15	1.05 – 1.15	.90 – 1.00
Hydrofluoric 30% drums, lb	.08 – .08½	.08 – .08½	.08 – .08½
Lactic, 44%, tech., light, bbl., lb	.06½– .06¾	.06½– .06¾	.06½– .06¾
Muriatic, 18°, tanks, cwt	1.05 –......	1.05 –......	1.05 –......
Nitric, 36°, carboys, lb	.05 – .05½	.05 – .05½	.05 – .05½
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –......	18.50 –20.00
Oxalic, crystals, bbl., lb	.10¾– .12	.10¾– .12	.10¾– .12
Phosphoric, tech., c'bys., lb	.07½– .08½	.07½– .08½	.07½– .08½
Sulphuric, 60°, tanks, ton	13.00 –......	13.00 –......	13.00 –......
Sulphuric, 66°, tanks, ton	16.50 –......	16.50 –......	16.50 –......
Tannic, tech., bbl., lb	.64 – .66	.64 – .66	.54 – .56
Tartaric, powd., bbl., lb	.63 –......	.63 –......	.39¼–......
Tungstic, bbl., lb	nom.......	nom.......	nom.......
Alcohol, amyl	......–......	......–......	......–......
From Pentane, tanks, lb	.121–......	.121–......	.101–
Alcohol, Butyl, tanks, lb	.10 –......	.10 –......	.09 –......
Alcohol, Ethyl, 190 p'f., bbl., gal	6.04 –......	6.04 –......	5.98 –......
Denatured, 190 proof	......–......	......–......	......–......
No. 1 special, dr., gal. wks.	.33 –......	.33 –......	.29½–......
Alum, ammonia, lump, bbl., lb	.03¾– .04	.03½– .04	.03½– .04
Potash, lump, bbl., lb	.04 – .04¼	.03¾– .04	.03¾– 04
Aluminum sulphate, com. bags, cwt	1.15 – 1.40	1.15 – 1.40	1.15 – 1.40
Iron free, bg., cwt	1.85 – 2.10	1.85 – 2.10	1.60 – 1.70
Aqua ammonia, 26°, drums, lb	.02¼– .03	.02¼– .03	.02¼– .03
tanks, lb	.02 – .02¾	.02 – .02¾	.02 – .02¾
Ammonia, anhydrous, cyl., lb	.16 –......	.16 –......	.16 –......
tanks, lb	.04½–......	.04½–......	.04½–......
Ammonium carbonate, powd. tech., casks, lb	.09 – .12	.09 – .12	.09 – .12
Sulphate, wks., cwt	1.45 –......	1.45 –......	1.40 –......
Amylacetate tech., from pentane, tanks, lb	.115–......	.15 –......	.10½–......
Antimony Oxide, bbl., lb	.13–......	.11½–......	.13 –......
Arsenic, white, powd., bbl., lb	.04 – .04½	.03¾– .04	.03 – .03½
Red, powd., kegs, lb	nom.......	nom.......	.17 – .18
Barium carbonate, bbl., ton	55.00 –60.00	55.00 –60.00	52.50 –57.50
Chloride, bbl., ton	79.00 –81.00	79.00 –81.00	79.00 –81.00
Nitrate, casks, lb	.09½– .10	.09½– .10	.08½– .10
Blanc fixe, dry, bbl., lb	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f.o.b., wks., drums, cwt	2.00 – 2.10	2.00 – 2.10	2.00 – 2.10
Borax, gran., bags, ton	43.00 –......	43.00 –......	43.00 –51.00
Bromine, cs., lb	.30 – .32	.30 – .32	.30 – .32
Calcium acetate, bags	3.00 –......	3.00 –......	1.90 –......
Arsenate, dr., lb	.07½– .07¾	.07½– .07¾	.06½– .06¾
Carbide drums, lb	.04¾– .05	.04¾– .05	.04¾– .05
Chloride, fused, dr., del., ton	19.00 –24.50	19.00 –24.50	19.00 –24.50
flake, dr., del., ton	20.50 –25.00	20.50 –25.00	20.50 –25.00
Phosphate, bbl., lb	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb	.73 –......	.66½–......	.66½–......
Tetrachloride drums, gal	.73 – .80	.66½– .73	.66½– .73
Chlorine, liquid, tanks, wks., lb	2.00 –......	1.75 –......	1.75 –......
Cylinders	.05¼– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb	1.84 – 1.87	1.84 – 1.87	1.84 – 1.87
Copperas, bgs., f.c.b. wks, ton	18.00 –19.00	18.00 –19.00	18.00 –19.00
Copper carbonate, bbl., lb	.18 – .20	.18 – .20	.10 – .16
Sulphate, bbl., cwt	5.00 – 5.25	5.00 – 5.25	4.60 – 4.85
Cream of tartar, bbl., lb	.52 –......	.52 –......	.34¼–......
Diethylene glycol, dr., lb	.22 – .23	.22 – .23	.22 – .23
Epsom salt, dom., tech., bbl., cwt.	1.90 – 2.00	1.90 – 2.00	1.80 – 2.00
Ethyl acetate, drums, lb	.08½–......	.08½–......	.07 –......
Formaldehyde, 40%, bbl., lb	.05½– .06	.05½– .06¼	.05½– .06
Furfural, tanks, lb	.09 –......	.09 –......	.09 –......
Fusel oil, drums, lb	.17½– .19	.17½– .19	.16 – .17
Glaubers salt, bags, cwt	1.05 – 1.10	1.05 – 1.10	.95 – 1.00
Glycerine, c.p., drums, extra, lb.	.14½–......	.14½–......	.12½–......
Lead:			
White, basic carbonate, dry casks, lb	.07½–......	.07½–......	.07 –......
White, basic sulphate, sck., lb	.07¼–......	.07¼–......	.06½–......
Red, dry, sck., lb	.0835......	.0835......	.07½–......
Lead acetate, white crys., bbl., lb.	.12 – .13	.12 – .13	.11 – .12
Lead arsenate, powd., bag, lb	.09½– .11	.09½– .11	.08½– .11
Lime, chem., bulk, ton	8.50 –......	8.50 –......	8.50 –......
Litharge, pwd., csk., lb	.0735......	.0735......	.06½–......
Lithopone, bags, lb	.0385– .04	.0385– .04	.036– .04
Magnesium carb., tech., bags, lb	.06¼– .06½	.06¼– .06½	.06¼– .06½

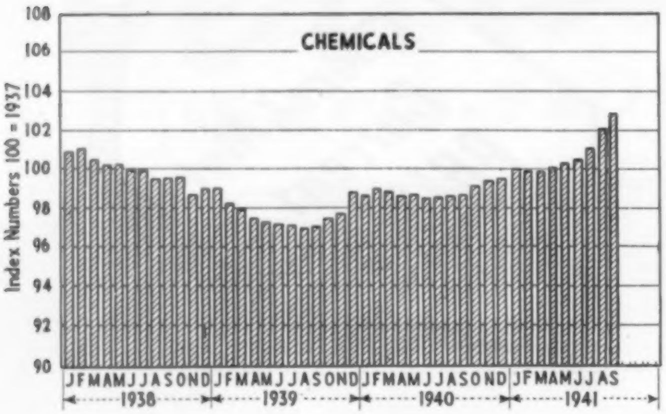
The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to September 12

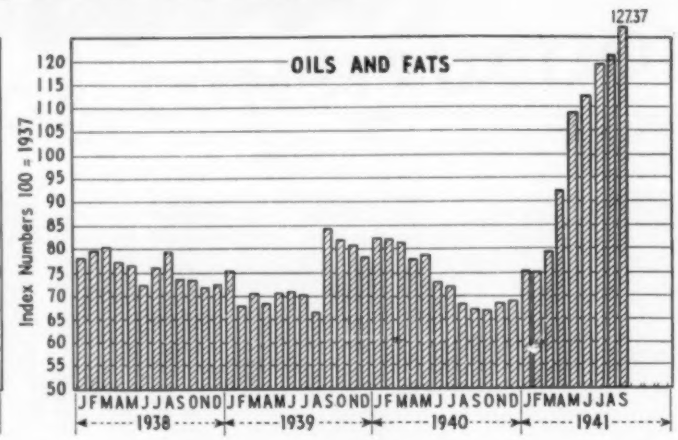
	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal	.73 –......	.73 –......	.29 –......
97%, tanks, gal	.75 –......	.75 –......	.30 –......
Synthetic, tanks, gal	.30 –......	.30 –......	.30 –......
Nickel salt, double, bbl., lb	.13½– .13½	.13½– .13½	.13 – .13½
Orange mineral, csk., lb	.11¼–......	.11¼–......	.10¼–......
Phosphorus, red, cases, lb	.40 – .42	.40 – .42	.40 – .42
Yellow, cases, lb	.18 – .25	.18 – .25	.18 – .25
Potassium bichromate, casks, lb	.09½– .10	.09½– .10	.08½– .09
Carbonate, 80–85%, calc. csk., lb	.06¼– .07	.06¼– .07	.06¼– .07
Chlorate, powd., lb	.10 – .12	.10 – .12	.10 – .12
Hydroxide (c'stic potash) dr., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Muriate, 60% bags, unit	.53½–......	.53½–......	.53½–......
Nitrate, bbl., lb	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb	.19½– .20	.19½– .20	.18½– .19
Prussiate, yellow, casks, lb	.17 – .18	.17 – .18	.15 – .16
Sal ammoniac, white, casks, lb	.0515– .06	.0515– .06	.05½– .06
Salsoda, bbl., cwt	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	17.00 –......	17.00 –......	23.00 –......
Soda ash, light, 58%, bags, contract, cwt	1.05 –......	1.05 –......	1.05 –......
Dense, bags, cwt	1.10 –......	1.10 –......	1.10 –......
Soda, caustic, 76%, solid, drums, cwt	2.30 – 3.00	2.30 – 3.00	2.30 – 3.00
Acetate, del., bbl., lb	.04½– .06	.04½– .06	.04 – .05
Bicarbonate, bbl., cwt	1.70 – 2.00	1.70 – 2.00	1.70 – 2.00
Bichromate, casks, lb	.07¾– .08	.07¾– .08	.06¾– .07
Bisulphate, bulk, ton	16.00 –17.00	16.00 –17.00	15.00 –16.00
Bisulphite, bbl., lb	.03 – .04	.03 – .04	.03 – .04
Chlorate, kegs, lb	.06¼– .06½	.06¼– .06½	.06¼– .06½
Cyanide, cases, dom., lb	.14 – .15	.14 – .15	.14 – .15
Fluoride, bbl., lb	.08 – .09	.08 – .09	.07 – .08
Hyposulphite, bbl., cwt	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt	2.35 – 2.40	2.35 – 2.40	2.35 – 2.40
Nitrate, bulk, cwt	1.47 –......	1.45 –......	1.45 –......
Nitrite, casks, lb	.06¾– .07	.06¾– .07	.06¾– .07
Phosphate, tribasic, bags, lb	2.35 –......	2.35 –......	2.25 –......
Prussiate, yel. drums, lb	.10½– .11	.10½– .11	.10½– .11
Silicate (40° dr.) wks., cwt	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60–62%, dr. lb	.03 – .03½	.02¾– .03	.02¾– .03
Sulphite, crys., bbl., lb	.02¼– .02½	.02¼– .02½	.02¼– .02½
Sulphur, crude at mine, bulk, ton	16.00 –......	16.00 –......	16.00 –......
Chloride, dr., lb	.03 – .04	.03 – .04	.03 – .04
Dioxide, cyl., lb	.07 – .08	.07 – .08	.07 – .07½
Flour, bag, cwt	1.60 – 3.00	1.60 – 3.00	1.60 – 3.00
Tin Oxide, bbl., lb	.55 –......	.55 –......	.51 –......
Crystals, bbl., lb	.39½–......	.39½–......	.39½–......
Zinc, chloride, gran., bbl., lb	.05 – .06	.05 – .06	.05 – .06
Carbonate, bbl., lb	.14 – .15	.14 – .15	.14 – .15
Cyanide, dr., lb	.33 – .35	.33 – .35	.33 – .35
Dust, bbl., lb	.09½–......	.09½–......	.08½–......
Zinc oxide, lead free, bag, lb	.06½–......	.06½–......	.06½–......
5% lead sulphate, bags, lb	.06½–......	.06½–......	.06¼–......
Sulphate, bbl., cwt	3.15 – 3.25	3.15 – 3.25	2.75 – 3.00

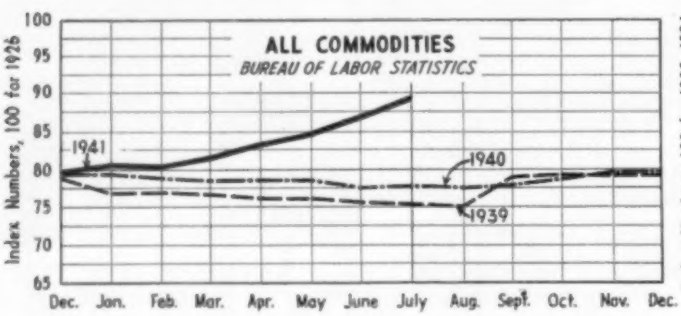
OILS AND FATS

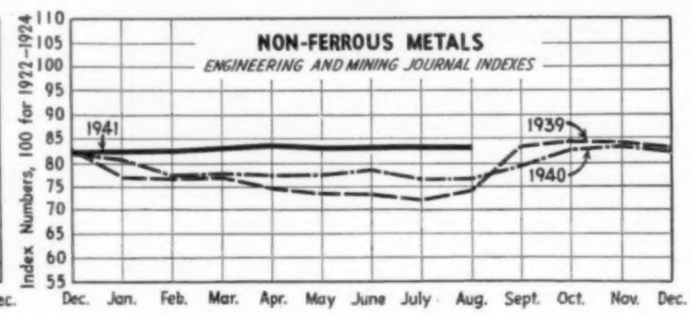
	Current Price	Last Month	Last Year
Castor oil, 3 bbl., lb	$0.11½–$0.12	$0.11½–$0.12	$0.10¾ –$0.11
Chinawood oil, bbl., lb	.34 –......	.33 –......	.26 –......
Coconut oil, Ceylon, tank, N. Y., lb	.07½–......	.07¼–......	.02¾–......
Corn oil crude, tanks (f.o.b. mill), lb	.11¼–......	.12 –......	.05½–......
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.12⅞–......	.10⅞–......	.04⅞–......
Linseed oil, raw car lots, bbl., lb	.113–......	.113–......	.084–......
Palm, casks, lb	.08 –......	.07 –......	.03½–......
Peanut oil, crude, tanks (mill), lb	.11½–......	.12 –......	.05½–......
Rapeseed oil, refined, bbl., lb	.15½–......	.15½–......	.12 –......
Soya bean, tank, lb	.09¾–......	.09¾–......	.04½–......
Sulphur (olive foots), bbl., lb	.16 –......	.16 –......	.08½–......
Cod, Newfoundland, bbl., gal	nom.......	nom.......	nom.......
Menhaden, light pressed, bbl., lb	.106–......	.104–......	.061–......
Crude, tanks (f.o.b. factory), gal	.60 –......	.60 –......	.30 –......
Grease, yellow, loose, lb	.08½–......	.07½–......	.03¾–......
Oleo stearine, lb	.09½–......	.09½–......	.05½–......
Oleo oil, No. 1	.11½–......	.10½–......	.06¼–......
Red oil, distilled, dp.p. bbl., lb	.10½–......	.10½–......	.06½–......
Tallow extra, loose, lb	.08½–......	.08 –......	.03½–......

Chem. & Met.'s Weighted Price Indexes









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-napthol, crude bbl., lb.	$0.52 –$0.55	$0.52 –$0.55	$0.52 –$0.55
Alpha-naphthylamine, bbl., lb.	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb.	.15 – .16	.15 – .16	.15 – .16
Aniline, salts, bbl., lb	.22 – .24	.22 – .24	.22 – .24
Benzaldehyde, U.S.P., dr., lb.	.85 – .95	.85 – .95	.85 – .95
Benzidine base, bbl., lb.	.70 – .75	.70 – .75	.70 – .75
Benzoic acid, U.S.P., kgs., lb.	.54 – .56	.54 – .56	.54 – .56
Benzyl chloride, tech., dr., lb.	.23 – .25	.23 – .25	.23 – .25
Benzol, 90%, tanks, works, gal.	.14 –	.14 –	.14 – .....
Beta-napthol, tech., drums, lb.	.23 – .24	.23 – .24	.23 – .24
Cresol, U.S.P., dr., lb.	.10¼– .10¾	.10¼– .10¾	.09½– .10
Cresylic acid, dr., wks., gal	.76 – .78	.76 – .78	.58 – .60
Diethylaniline, dr., lb.	.40 – .45	.40 – .45	.40 – .45
Dinitrophenol, bbl., lb	.23 – .25	.23 – .25	.23 – .25
Dinitrotoluol, bbl., lb	.18 – .19	.18 – .19	.15½– .16
Dip oil, 15%, dr., gal.	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, dr. fob wks., lb.	.70 –	.70 –	....
H-acid, bbl., lb.	.45 – .50	.45 – .55	.45 – .50
Naphthalene, flake, bbl., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Nitrobenzene, dr., lb.	.08 – .09	.08 – .09	.08 – .09
Para-nitraniline, bbl., lb.	.47 – .49	.47 – .49	.47 – .49
Phenol, U.S.P., drums, lb.	.12½–	.12½–	.13 – .....
Picric acid, bbl., lb.	.35 – .40	.35 – .40	.35 – .40
Pyridine, dr., gal	1.70 – 1.80	1.70 – 1.80	1.70 – 1.80
Resorcinol, tech., kegs, lb.	.75 – .80	.75 – .80	.75 – .80
Salicylic acid, tech., bbl., lb.	.33 – .40	.33 – .40	.33 – .40
Solvent naptha, w.w., tanks, gal.	.27 –	.27 –	.27 – .....
Tolidine, bbl., lb	.86 – .88	.86 – .88	.86 – .88
Toluol, drums, works, gal.	.32 –	.30 –	.30 – .....
Xylol, com, tanks, gal.	.26 –	.26 –	.26 – .....

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$22.00–$25.00	$22.00–$25.00	$22.00–$25.00
Casein, tech, bbl, lb.	.29– .31	.21½– .22	.11½– .13
China clay, dom., f.o.b. mine, ton.	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors			
Carbon gas, black (wks.), lb.	.0335– .30	.0335– .30	.028– .30
Prussian blue, bbl., lb.	.36 – .37	.36 – .37	.36 – .37
Ultramarine blue, bbl., lb.	.11 – .26	.11 – .26	.10 – .26
Chrome green, bbl., lb.	.21½– .30	.21½– .30	.21 – .27
Carmine, red, tins. lb.	4.60 – 4.75	4.60 – 4.75	4.85 – 5.00
Para toner, lb.	.75 – .80	.75 – .80	.75 – .80
Vermilion, English, bbl., lb.	3.20 – 3.25	3.20 – 3.25	nom
Chrome yellow, C.P., bbl., lb.	.14½– .15½	.14½– .15½	.14½– .15½
Feldspar, No. 1 (f.o.b.N.C.), ton.	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb.	.08 – .10	.08 – .10	.06 – .06½
Gum copal Congo, bags, lb.	.09 – .30	.09 – .30	.06 – .30
Manila, bags, lb.	.09 – .15	.09 – .14	.09 – .14
Damar, Batavia, cases, lb.	.10 – .22	.10 – .20	.08 – .24
Kauri, cases, lb.	.18 – .60	.18 – .60	.18½– .60
Kieselguhr (f.o.b. mines), ton.	7.00 –40.00	7.00 –40.00	7.00 –40.00
Magnesite, calc, ton.	65.00 –	65.00 –	65.00 – .....
Pumice stone, lump, bbl., lb.	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb.	nom	nom	.03 – .04
Rosin, H., 100 lb.	3.12 –	3.08 –	2.24 – .....
Turpentine, gal.	.81 –	.74 –	.37½– .....
Shellac, orange, fine, bags, lb.	.38 –	.38 –	.26 – .....
Bleached, bonedry, bags, lb.	.35 –	.35 –	.25 – .....
T. N. Bags, lb.	.28 –	.28 –	.14 – .....
Soapstone (f.o.b. Vt.), bags, ton.	10.00 –12.00	10.00 –12.00	10.00 –12.00
Talc. 200 mesh (f.o.b. Vt.), ton.	8.00 – 8.50	8.00 – 8.50	8.00 – 8.50
200 mesh (f.o.b. Ga.), ton.	6.00 – 8.00	6.00 – 8.00	7.50 –11.00

Industrial Notes

CHAIN BELT CO., Milwaukee, has announced that J. Walter Snavely, district manager in the Houston territory for seven years, has returned to the sales department of the conveying and engineering division at Milwaukee.

GOLWYNNE MAGNESITE AND MAGNESIA CORP., New York, has changed its name to Golwynne Chemicals Corp.

MICHIGAN ALKALI CO., has consolidated its general sales and executive offices in the Ford Bldg., Detroit. An eastern branch will be maintained at 60 East 42d St., New York, and branch offices also will be maintained at Chicago, Cincinnati, and St. Louis.

WHEELCO INSTRUMENTS CO., Chicago, has moved into its own building at Harrison and Peoria Streets.

AMERICAN ENGINEERING CO., The Hele-Shaw Pump Division, Philadelphia, has appointed R. S. Ernst as representive in Indiana, Wisconsin, and part of Illinois with headquarters at 844 Rush St., Chicago.

MUNN AND STEELE, INC., Newark, N. J., has acquired the assets of Celo Mines, Inc., at Burnsville, N. C., under the corporate title of Mas Celo Mines, Inc.

THE DICALITE CO., New York, has opened a branch office in the Ellicott Square Bldg., Buffalo, with A. B. Leachy as manager. Also a branch office at 629 Euclid Ave., Cleveland, with H. L. Dunham in charge.

HANDY & HARMAN, New York, has brought J. W. Colgan from the Toronto office to New York to act as sales manager.

THE OHMITE MANUFACTURING CO., Chicago, has completed an addition to its plant on West Flournoy St., which doubles its production space.

THE FOXBORO CO., Foxboro, Mass., has appointed E. B. Miller manager of its office at 3615 Olive St., St. Louis, with R. M. H. Hemfelt as assistant. E. R. Huckman, formerly manager at St. Louis has been transferred to the New York territory.

FOOD MACHINERY CORP., Peerless Pump Division, Los Angeles, has moved its eastern offices and manufacturing facilities from Massillon, Ohio, to a new plant at 1250 Camden Ave., S. W., Canton.

CLARK BROS. CO., INC., Olean, N. Y., has opened a Pacific Coast office in charge of A. K. Hegeman at the plant of the Pacific Pump Works, Huntington Park, Calif.

BAILEY METER CO., Cleveland, is now operating its own branch office in the Curtis Bldg., Detroit. N. M. Barnet is in charge assisted by R. F. Hanson and R. T. Cowan.

ELECTRO METALLURGICAL CORP., New York, has appointed Charles Hardy, Inc., 420 Lexington Ave., as its sales agency for calcium metal.

Insure your Supply of Solvents

. . . and lower your costs with a "Columbia" Activated Carbon Solvent Recovery Plant

TO assure yourself an adequate supply of solvents and to lower your operating costs, it is now more important than ever to recover solvents vaporized in your operations. You can do this efficiently, safely, and at low cost with the "Columbia" Activated Carbon system. Recovery plant efficiencies usually exceed 99 per cent.* Recovered vapor concentrations are automatically maintained well below the explosive range. This is an important safety feature. Recovery expense is sometimes less than 0.2 cents a pound, and almost never exceeds 1 cent a pound.

We can design and supply complete "Columbia" Activated Carbon plants with guaranteed operating characteristics to recover almost all volatile solvents or solvent mixtures. This ability is fortified by more than 15 years' experience in the design of solvent recovery plants, both large and small, for many industries; by our broad knowledge of the production, separation, and purification of solvents; by the help of affiliated companies in the selection of special alloys and the fabrication of equipment for optimum performance; and by our development of special solvent recovery grades of activated carbon for maximum efficiency and long service life.

*Less than one per cent of the solvent vapors collected from the vaporizing operation is lost. Over-all recoveries of all solvent used vary with the vaporizing operation and the type of vapor-collecting system, but have been higher than 95 per cent.

Some Solvents That Can Be Readily Recovered with the "Columbia" Activated Carbon System

ALCOHOLS
Methanol, ethanol, isopropanol, butanol.

CHLORINATED COMPOUNDS
Carbon tetrachloride, ethylene dichloride, dichlorethylene, trichlorethylene, perchlorethylene, methyl chloride, methylene chloride, propylene dichloride, trichloracetylene.

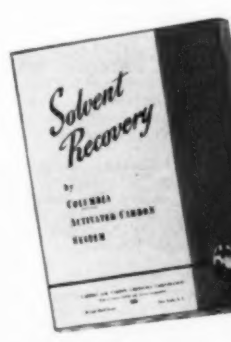
ESTERS
Methyl acetate, ethyl acetate, isopropyl acetate, butyl acetate, amyl acetate.

ETHERS
Ethyl ether, isopropyl ether.

HYDROCARBONS
Benzol, toluol, xylol, petroleum ether, mineral spirits, naphtha, gasoline.

KETONES
Acetone, methyl ethyl ketone, hexone.

MISCELLANEOUS
Carbon bisulfide, and others.



WRITE FOR THIS BOOK . . .

For further information about the "Columbia" Activated Carbon system and its profitable use, send for this 32-page book. When you write for a copy, tell us the nature of your operation, what solvents you vaporize, and how you collect the vapors, so that we can help you estimate what and where you can save. No obligaton, of course.

The word "Columbia" is a registered trade-mark of Carbide and Carbon Chemicals Corporation.

Representative Industries For Which We Have Designed and Supplied Complete Solvent Recovery Plants Include: *Rayon, Artificial Leather, Lacquer Coatings, Rubber, Rotogravure Printing, Smokeless Powder, Plastics, and Transparent Wrappings.*

For information concerning the uses of "Columbia" Activated Carbon, address:

CARBIDE AND CARBON CHEMICALS CORPORATION

Unit of Union Carbide and Carbon Corporation

UCC

30 East 42nd Street, New York, N. Y.

PRODUCERS OF SYNTHETIC ORGANIC CHEMICALS

Chem & Met New Construction

	Current Projects: Proposed Work	Current Projects: Contracts	Cumulative 1941: Proposed Work	Cumulative 1941: Contracts
New England	$300,000	....	$2,825,000	$4,378,000
Middle Atlantic	14,000,000	$835,000	27,600,000	32,537,000
South	800,000	1,041,000	43,593,000	216,691,000
Middle West	440,000	1,405,000	4,805,000	116,643,000
West of Mississippi	25,500,000	11,040,000	57,805,000	111,300,000
Far West	11,540,000	....	13,222,000	31,060,000
Canada	....	....	1,972,000	1,935,000
Total	$52,580,000	$14,321,000	$151,822,000	$514,544,000

PROPOSED WORK

Arkansas—Aluminum Co. of America, Gulf Bldg., Pittsburgh, Pa., plans to construct an alumina plant here to have an annual capacity of 400,000,000 lbs., also an aluminum smelting plant to have a capacity of 100,000,000 lb. Sites have not been selected. Both plants will be for the War Dept. and will be financed by Defense Plant Corp. Estimated cost $13,000,000 and $11,000,000 respectively.

Ark., Magnolia—Shell Oil Co., El Dorado, plans to increase the capacity of its casinghead plant from 15,000,000 to 20,000,000 ft. daily capacity. Estimated cost $200,000.

Idaho, Kellogg—Bunker Hill & Sullivan Mining & Concentration Co., Kellogg, plans to construct a fuming plant at its smelter to recover lead, zinc and cadmium from slag. Estimated cost $500,000.

Ill., Monsanto—(Br. East St. Louis)—War Dept., 20th and Constitution Aves., N. W., Wash., D. C., plans to construct a plant to manufacture protective chemicals for the Chemical Warfare Service, Monsanto Ave. and Falling Springs Rd. Estimated cost $400,000.

Ind., Mt. Vernon—Indiana Farm Bureau, R. L. Booker, Mgr, plans to alter refinery here to manufacture high octane gasoline. Estimated cost including equipment $40,000 or more.

La., Cedar Grove—Brown Strauss Corp., 1446 Guinotte St., Kansas City, Mo., and Shreveport, La., plans to improve and enlarge existing refinery at Cedar Grove near Shreveport. Estimated cost $100,000.

Mo., St. Louis—Laclede-Christy Clay Products Co., 411 North 7th St., plans to construct additions to its plant on Manchester Ave. near Kingshighway Blvd. Estimated cost including equipment $1,000,000.

Nev., Las Vegas—Blue Diamond Gypsum Mines, I. King, Mgr., plans to construct a plant here for the manufacture of gypsum products. Estimated cost $40,000.

N. Y., Massena—Aluminum Co. of America, Gulf Bldg., Pittsburgh, Pa., plans to construct an aluminum smelter here to have an annual capacity of 150,000,000 lb. Plant will be for War Dept. and will be financed by Defense Plant Corp. Estimated cost $14,000,000.

Ore., Bonneville—Aluminum Co. of America, Gulf Bldg., Pittsburgh, Pa., plans to construct an aluminum smelter here to have an annual capacity of 90,000,000 lb. Plant will be for War Dept. and will be financed by Defense Plant Corp. Estimated cost $11,000,000.

Tenn., Memphis—Tennessee Powder Co., c/o E. I. du Pont de Nemours & Co., Du Pont Bldg., Wilmington, Del., plans to construct a powder plant here for the War Dept. Project will be financed by Defense Plant Corp. Estimated cost $550,000.

Tenn., Nashville—Tennessee Products Corp., American Natl. Bank Bldg., plans to recondition ferro-manganese furnace here for Navy Dept. Defense Plant Corp. will finance project. Estimated cost $150,000.

Tex., Deer Park—Shell Refining Co., Shell Bldg., Houston, plans to construct an aviation gasoline refining unit. Estimated cost $300,000.

Vt., Brattleboro—American Optical Co., Mechanic St., Southbridge, Mass., plans to construct a lens grinding plant. Project will be financed by Defense Plant Corp. Estimated cost $300,000.

CONTRACTS AWARDED

Ky., Lexington—Department of Highways, Lexington, has awarded the contract for a highway materials research laboratory at the University of Kentucky to Skinner Bros., Lexington, at $41,277.

Md., Baltimore—Baugh Chemical Co., 25 South Calvert St., has awarded the contract for a 1 story, 75x75 ft., 1 story 50x132 ft. and 1 and part 2 story, 50x240 ft. storage warehouses to Lumbach & Williams, 30 West Biddle St. Estimated cost $75,000.

Mich., Detroit—Sulphite Pulp & Paper Co., 9125 West Jefferson Ave., has awarded the contract for a 1 story plant addition to W. J. C. Kauffman Co., 10610 Shoemaker Ave., Detroit. Estimated cost $40,000.

Mich., Kalamazoo—Upjohn Co., has awarded the contract for a 1 story, 150x280 ft. factory and warehouse addition to chemical plant to Miller-Davis Co., Kalamazoo. Estimated cost $75,000.

N. J., Elizabeth—Linde Air Products Co., Linden Ave., E., has awarded the contract for altering and constructing addition to its plant to Ochswald Construction Co., 854 Clinton Ave., Newark. Estimated cost $40,000.

N. J., Hillside—Bristol-Myers Co., Hillside, has awarded the contract for a 5 story manufacturing building to Wigton-Abbott Corp., Plainfield, N. J. Estimated cost will exceed $40,000.

Ill., Chicago Heights—Victor Chemical Co., 141 W. Jackson St., Chicago, Ill., has awarded the contract for a 3 story, 75x110 ft. addition to plant to J. W. Snyder Co., 307 N. Michigan Ave., Chicago. Estimated cost $75,000.

Ill., Chicago—U. S. Chemicals, Inc., 380 W. 38th St., Chicago, has awarded the contract for constructing a 2 story, 150x200 ft. warehouse at Stickney, Cook County, to W. J. Barney Corp., 101 Park Ave., New York, N. Y. Estimated cost $175,000.

Ind., Jeffersonville — Colgate-Palmolive-Peet Co., 105 Hudson St., Jersey City, N. J., has awarded the contract for constructing a manufacturing building to Turner Constr. Co., 420 Lexington Ave., New York, N. Y. Estimated cost $500,000.

Mo., St. Louis—Monsanto Chemical Co., 1700 South Second St., St. Louis, has awarded the contract for constructing a 1 story, 60x120 ft. warehouse at 137 West Russell Ave., to Fruin-Colnon Contracting Co., 502 Merchants-Laclede Bldg., St. Louis. Estimated cost $40,000.

N. J., New Brunswick—Johnson & Johnson, 500 George St., have awarded the contract for second floor, 70x120 ft. addition to Bldg. No. 11 and alterations to Bldg. No. 49, to Rogers & Sons Construction Co., 71 John St., New Brunswick.

N. J., Rahway—Merck & Co., 126 East Lincoln Ave., has awarded the contract for a 2 story, 50x100 ft. addition to research chemistry laboratory building to Walter Kidde Constructors, Inc., 140 Cedar St., New York, N. Y.

N. Y., Glens Falls—Imperial Paper & Color Corp., Warren St., has awarded the contract for 45x150 ft. factory to Charles E. Waggaman, Glens Falls. Estimated cost $40,000.

N. Y., Niagara Falls—Niagara Alkali Co., 4205 Buffalo Ave., Niagara Falls, has awarded the contract for constructing 1 and 2 story, 70x20 ft., 70x142 ft. and 24x35 ft. additions to its plant to Gaylord S. Guenther & Co., 611 8th St., Niagara Falls. Estimated cost including equipment $40,000.

N. Y., Niagara Falls—Great Lakes Carbon Corp., Pine Ave., Niagara Falls, has awarded the contract for a 70x200 ft. addition to its plant to Laur & Mack Contracting Co., 1400 College Ave., Niagara Falls. Estimated cost $50,000.

N. Y., Niagara Falls—National Carbon Co., Inc., Highland Ave., has awarded the contract for 93x450 ft. and 134x210 ft. plant buildings to Scrufari Construction Co., Inc., 825 15th St. Estimated cost $200,000.

N. Y., Niagara Falls—Vanadium Corp. of America, Saunders Settlement Rd., has awarded the contract for a laboratory to Rust Engineering Co., Clark Bldg., Pittsburgh, Pa. Estimated cost $40,000.

O., St. Marys—St. Marys Manufacturing Co., St. Marys, has awarded the contract for a pliofilm plant addition to G. Everett Knowlton & Son, Holley Bldg., Bellefontaine. Estimated cost including equipment $500,000.

Pa., Foster Brook (Bradford P. O.)—Kendall Refining Co., O. Koch, Pres., Kendall Ave., will improve and construct additions to its plant. Work will be done by own forces and separate contracts. Estimated cost will exceed $40,000.

Pa., Philadelphia—Atlantic Refining Co., 260 South Broad St., has awarded the contract for a 70x215 ft. warehouse addition to Lauter Construction Co., Otis Bldg. Estimated cost $40,000.

Pa., Port Allegany—Pittsburgh Corning Glass Corp., Port Allegany, has awarded the contract for a manufacturing building to H. K. Ferguson Co., Hanna Bldg., Cleveland, O. Estimated cost $150,000.

Tex., Freeport—Dow Chemical Co., Freeport, and Midland, Mich., has awarded the contract for the construction of a synthetic ammonia plant to Austin Co. and M. K. Kellogg Co., M & M Bldg., Houston. Project will be financed by Defense Plant Corp. Estimated cost $11,000,000.

W. Va., Fairmont—Westinghouse Electric & Mfg. Co., Geo. H. Parkman, Dir. Building Construction & Maintenance, East Pittsburgh, Pa., will construct a 2 story, 240x450 ft. glass manufacturing plant here. Work will be done by separate contracts. Estimated cost $1,000,000.

Wis., Kaukauna—Thilmany Pulp & Paper Co., Kaukauna, has awarded the contract for a 1 and 2 story, 70x300 ft. paper mill to Permanent Construction Co., 2712 North Holton St., Milwaukee.